ALUMINUM IN MODERN ARCHITECTURE '58

4.00

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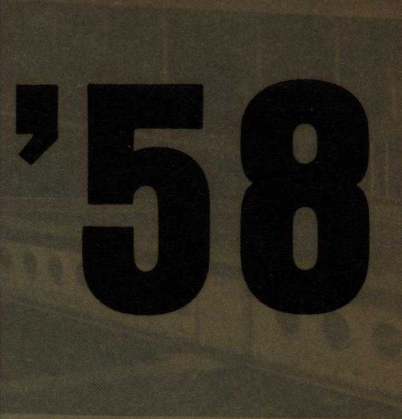

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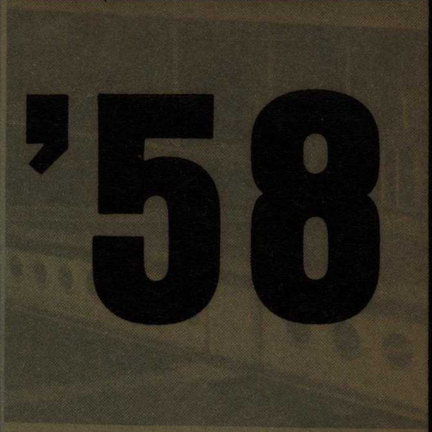
An International Review of

Aluminum in Modern Architecture

1958 Edition

Companion to **Aluminum in Modern Architecture** Volumes I & II


'58

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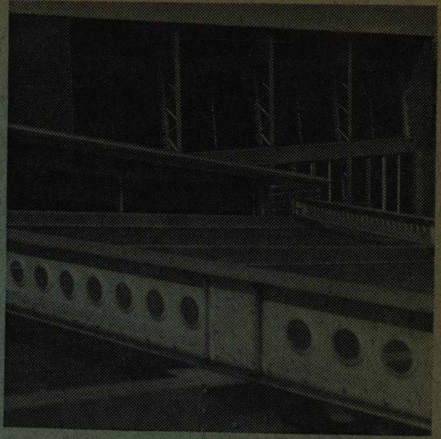

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Introduction

This is the first annual supplement to "Aluminum in Modern Architecture," Volumes I and II. Our times have seen a tremendous breakthrough in the technical limitations of building materials. Research and development, design and construction have been so accelerated that it is often difficult for information to keep pace. Nowhere is this more evident than in the widening use of the light metal, aluminum This annual is designed to bring you up-to-date on the architectural development of this twentieth-century building material.

This 1958 issue contains data on twenty-seven buildings erected since "Aluminum in Modern Architecture" went to press two years ago. They by no means represent all the celebrated buildings using aluminum that have been built during this period. They do, however, present more than two dozen important examples of the art of architecture whose designers' names read like an international honor roll of modern architecture. They show some of the steadily increasing ways in which aluminum is being employed in building today. In our selection, the emphasis has been on two things—architectural quality and an imaginative use of aluminum.

It would be difficult to find a building which better qualifies on both counts than the one which introduces the buildings section of the annual, on Page 11. It is the winner of the first R. S. Reynolds Memorial Award, made each year by the American Institute of Architects to the architect or architects who have "made the most significant contribution to the use of aluminum, aesthetically or structurally, in the building field."

A distinguished jury, including Willem Dudok of the Netherlands, Mies van der Rohe, George Bain Cummings, and Edgar I. Williams of the United States, selected an employee recreation building designed by three young Spanish architects to receive the $25,000 award. It was the extensive and attractive structural use of aluminum which especially commended this building to the judges.

The increasing structural use of aluminum, especially in Europe, represents one of the important trends seen in this year's annual. That celebrated American development, the curtain-wall, which has been widely heralded as the first genuine mass-production component of the age looking toward prefabrication, is shown in some recent U. S. examples. The merit of the curtain-wall idea is indicated by its rapid adoption abroad. Some elegant transatlantic versions of curtain-wall construction attest to the skill with which it is now being handled in Europe.

Sun-control systems to make buildings more comfortable and ease the load on air-conditioning systems are another design element that is receiving increased attention from architects. Because of two outstanding features—light weight and low maintenance requirements—aluminum is finding increasing use in louvers and overhangs. These are just a few of the developments you will find in the buildings section of "Aluminum in Modern Architecture 1958."

The Symposium on Aluminum in International Architecture held some months ago in West Berlin provided an opportune and unrivaled review of technical developments in aluminum. A distinguished panel of architects and engineers from all over the world, including Paul Weidlinger, author of "Aluminum in Modern Architecture, Volume II," who represented the United States, reported on the technical advances in their respective countries. Their edited reports, along with photographs taken at the conference, begin on Page 70.

The first article in a series planned to acquaint designers with the basic aluminum processes and techniques deals with the colorful and controversial subject of anodizing. Starting on Page 87 is a clear and authoritative presentation of this important process which holds such a bright promise for the future of architecture.

For a realistic glimpse of the future development of both architecture and aluminum we have continued our series of tape-recorded conversations with architects and engineers internationally renowned for their insight and inspiration. These are the kind of men whose ideas are changing the face of the world.

For your convenience, the new material in this annual has been indexed by building, architect and aluminum products along with an index that covers the contents of both the preceding volumes. The authoritative bibliography of architectural aluminum, begun in Volumes I and II, has been extended in this 1958 supplement.

It is our hope that "Aluminum in Modern Architecture 1958" will find an honored place beside "Aluminum in Modern Architecture"; that together they will provide a useful source of information and inspiration concerning this remarkable lightweight material.

Aluminum in Modern Architecture

Visitor and Factory Lounge
SEAT Automobile Plant

Barcelona, 1956
Rafael de la Joya,
Manuel Barbero-Rebolledo and
Cesar Ortiz Echague
Winners of First Annual R. S. Reynolds Award

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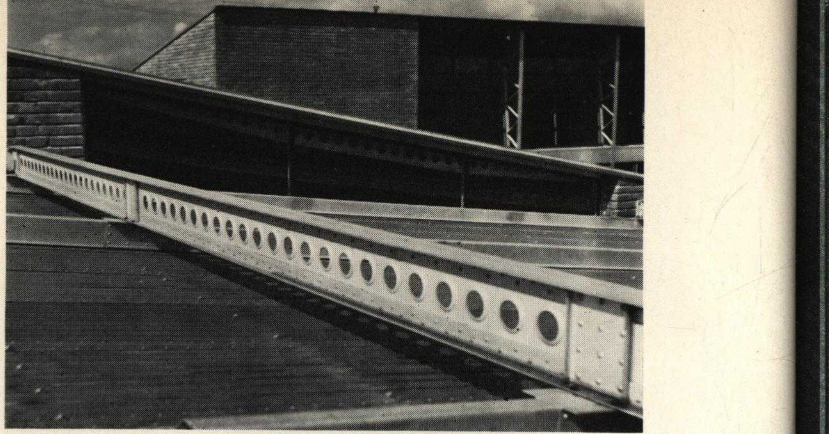
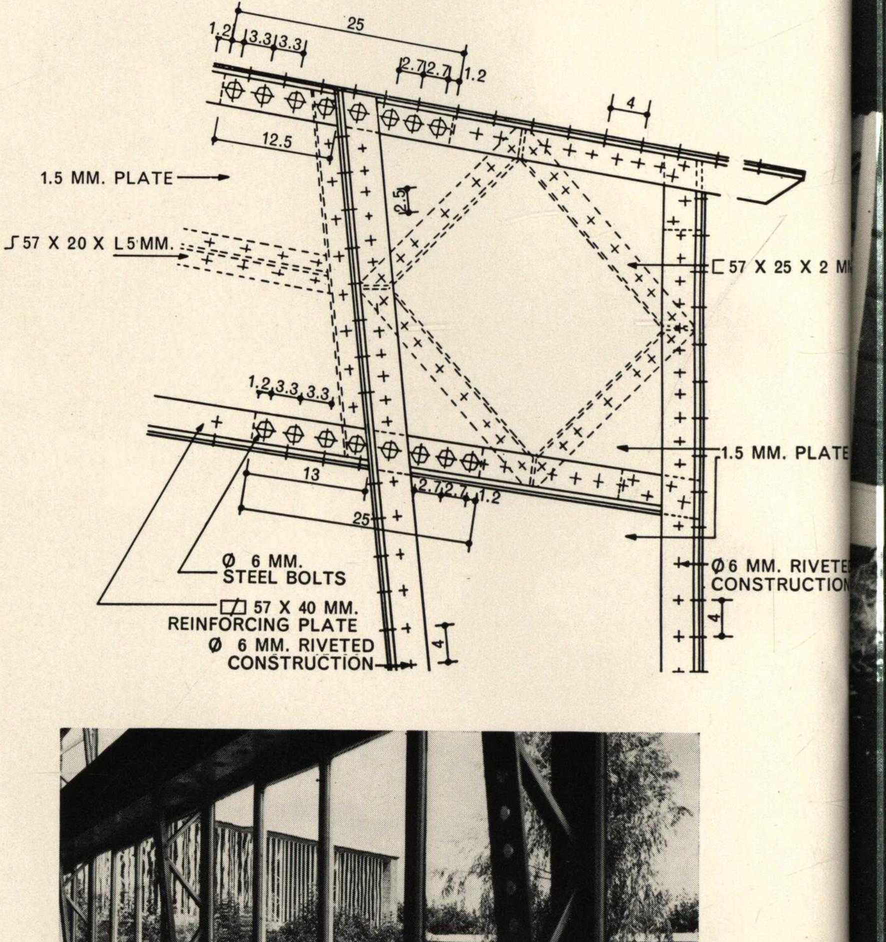


Above The aluminum structural members can be seen here at roof level. **Below** This detail drawing shows the construction of aluminum supports.



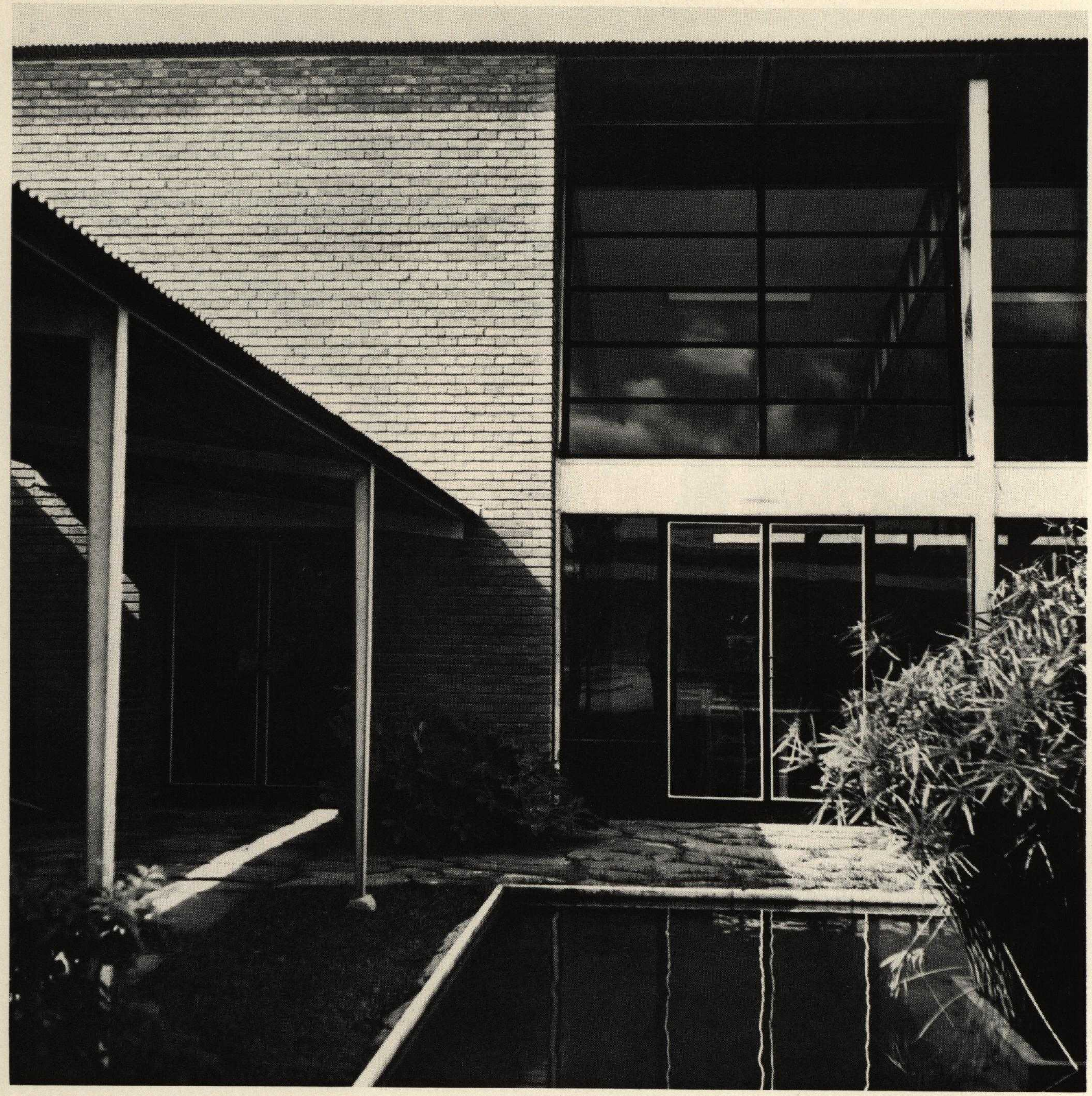
The three serious architects on the preceeding page are the first recipients of the annual R.S. Reynolds Memorial Award. A distinguished jury selected by the American Institute of Architects; George Bain Cummings, Willem Dudok, Percival Goodman, Ludwig Meis van der Rohe and Edgar I. Williams, determined that Rafael de la Joya, Manuel Barbero-Rebolledo and Cesar Ortiz Echague had in 1957 made "the most significant contribution to the use of aluminum in the building field." The award was noteworthy in all respects and happily surprising in several. Spain for instance is a country far less known for modern architecture than others today. Also the building itself is of a type only beginning to receive attention in the United States — employee facilities.

The project was an employee lounge and dining hall for the two thousand workers of the S.E.A.T. Automobile Plant in Barcelona. The company wanted a low maintenance building near but not in the direction of future plant expansion. The site chosen had to be raised above the level of local floods and this filled-in ground demanded lightweight construction. Wide use of aluminum was decided upon because of these specifications. The architects, who, in spite of their youth (all are in their thirties), head the largest architectural office in Spain, have produced a building lively and imaginative, cheerful and modern.

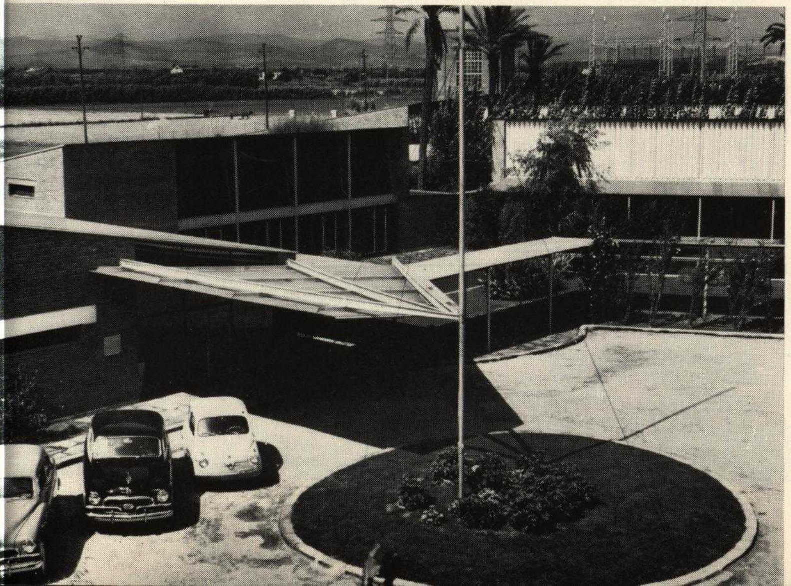
The jury selected this building because its use of aluminum was in keeping with both the architectural needs and the materials special properties. Furthermore, the architects' straight forward handling of aluminum in structural members as well as in the enclosing and finishing elements particularly impressed them as being imaginative and tasteful.

To the architects, the challenge of this building was to provide a pleasing environment for the relaxation of personnel engaged

Right This view from one of the five dining halls shows the effectiveness of the exposed structural members and glass in achieving a feeling of transparency. **Far Right** Dining halls overlooking the gardens are all connected by walkways covered with rigid corrugated aluminum roofing. These lend a sense of unity to the individual sections.



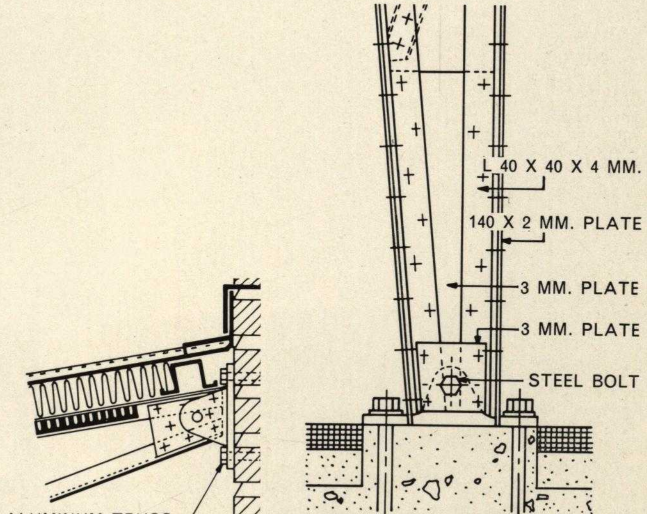
Above All elements used by the architects are shown here. Aluminum for lightness and newness, brick for isolation and tradition, glass which connects them without impairment and nature which flourishes in the gardens here along the Spanish Mediterranean.



in humdrum assembly-line production. They decided to solve this by making nature a leading element of the architecture. The buildings are conceived as a place for privacy and for protection against the weather.

To prevent "anonymous crowding" the architects designed five separate dining halls plus a complete kitchen and combined them with a series of six Spanish Gardens and courts, unifying the areas with a series of covered walks. One of the dining halls can also be used as an exhibition hall or reception area for visitors.

The main frame of the building is a completely exposed structural grill of aluminum. Corrugated aluminum sheets form the roofing. In the walls, aluminum and glass achieve transparency — a view of the surrounding nature. Brick affords privacy. Both aluminum and brick are treated independently without plastering or coating and without intermingling. Their only bond is the glass which connects them. The aluminum parts successfully resist the extremes of the climate: reflecting the brilliant sun, maintaining watertight connections against the heavy rains and resisting the corrosive effects of a seaside atmosphere. Here is a low maintenance, modern factory addition with style and a social point of view.



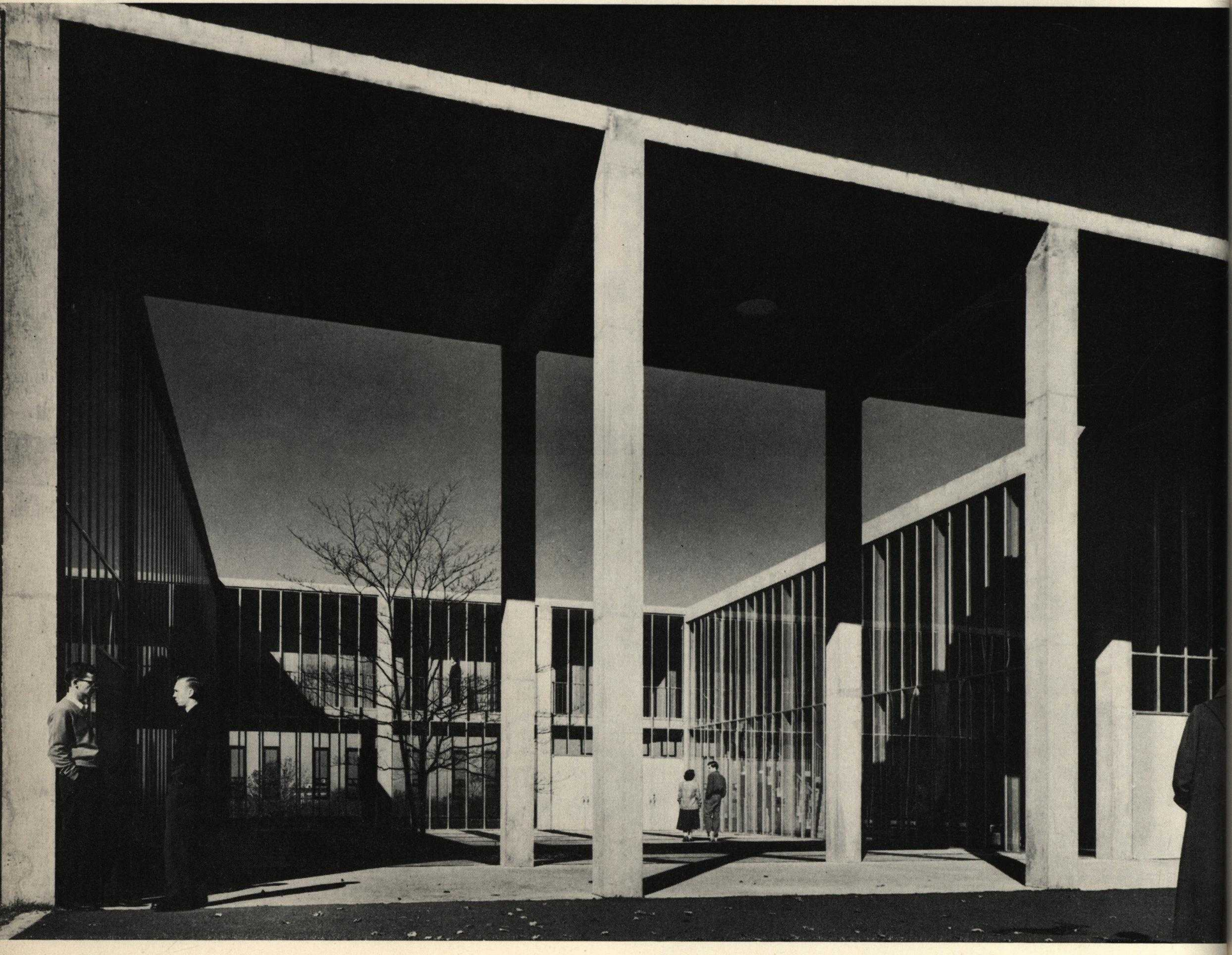
ALUMINUM TRUSS ANCHORED TO MASONRY

ALL STRUCTURAL MEMBERS ARE OF ALUMINUM UNLESS OTHERWISE NOTED

Left Top While the interior is air conditioned, protection against the strong Spanish sun is achieved by the covered walkways and electrically activated louvers. **Left Bottom** The aluminum flagpole at the entrance is made a integral part of the complex by bracing from three points on the canopy with drilled beams. **Above** These detail drawings show how the aluminum members are fixed to foundation and masonry.

Samuel Tyndale Wilson Chapel

Maryville College
Maryville, Tennessee, 1955
Paul Schweikher and Winston Elting

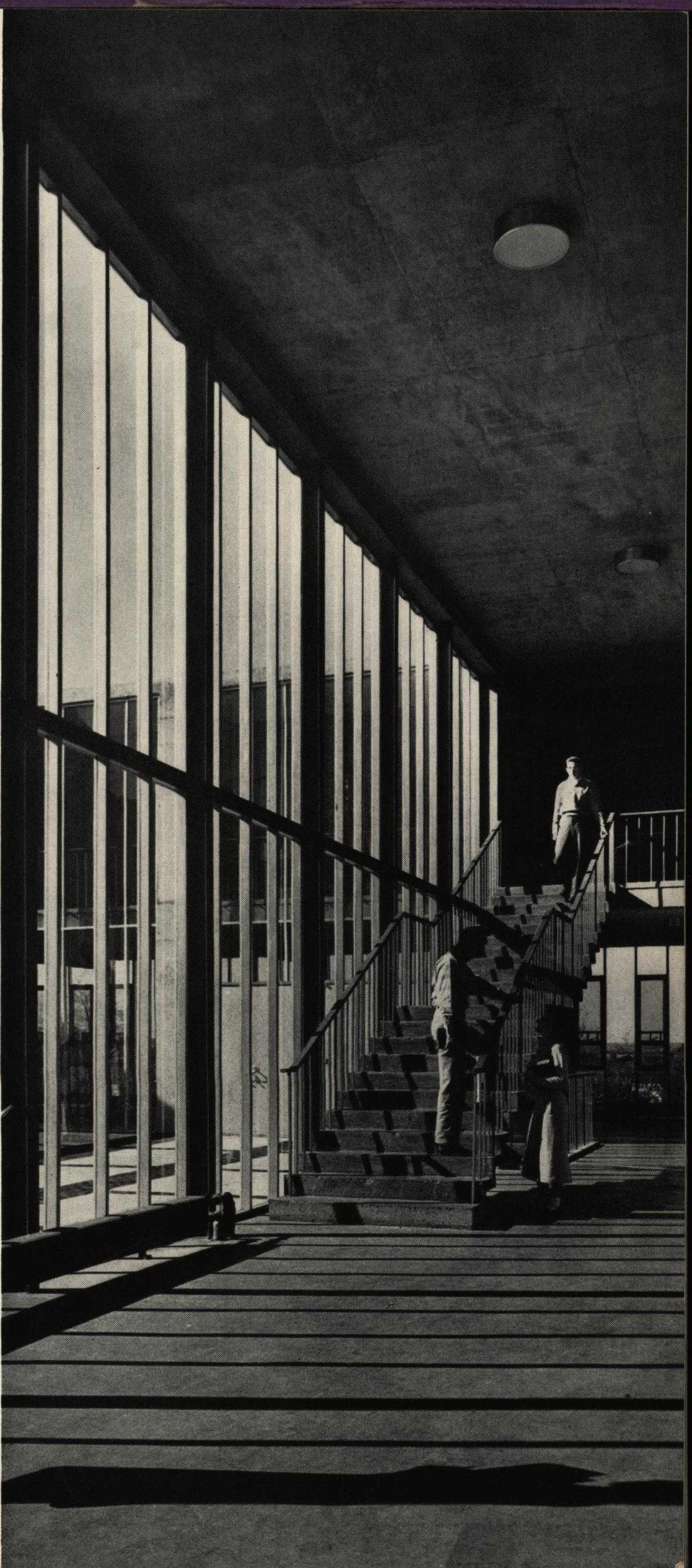


Though normally referred to as "The Chapel," this Maryville College building is actually four in one. An auditorium, theater, chapel and outside hall have been skillfully organized within a unifying pavillion. The result achieved by architects Schweiker and Elting is remarkable for both its seeming simplicity and its subtle sophistication.

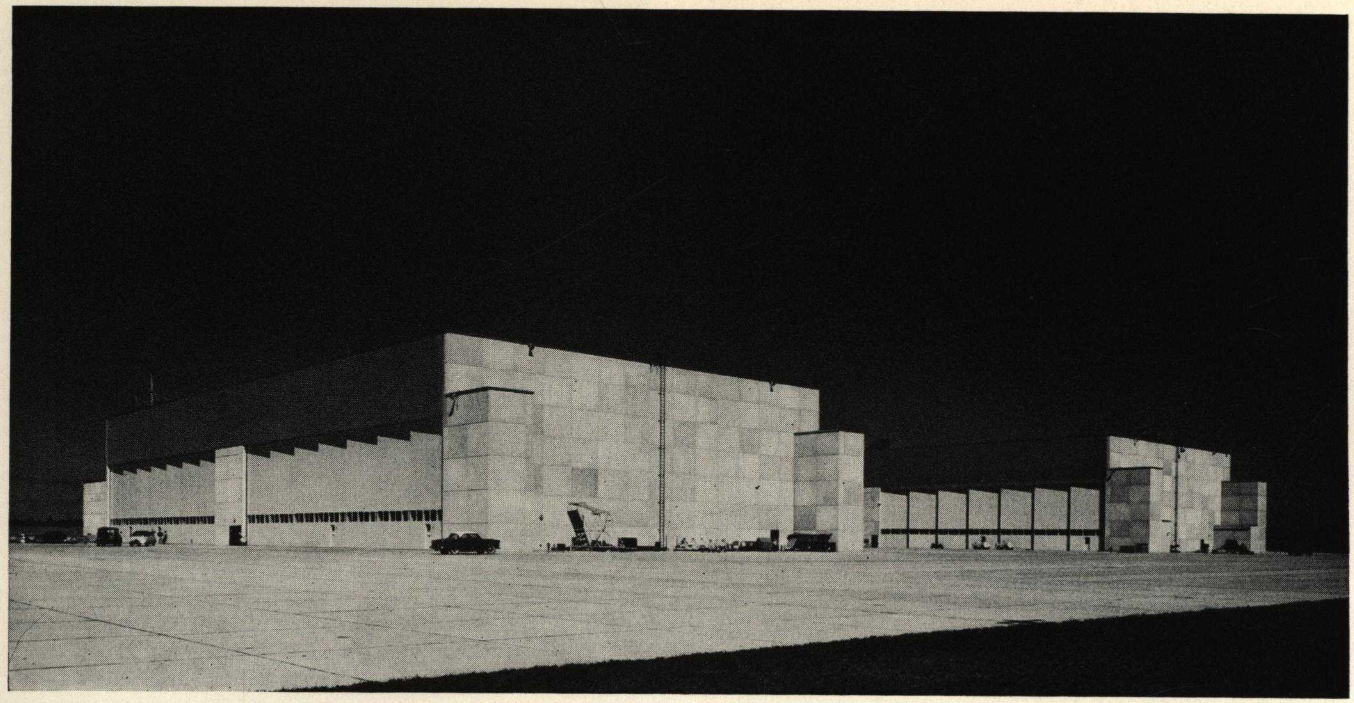
The theme of unity in diversity is architecturally emphasized by having the structural and nonstructural parts of the building "joined by separation." Masonry panels in great variety and deliberately nonstructural in quality are separated from the reinforced concrete frame by wide, untooled mortar joints. Stairways are left free standing and stair railings do not meet walls as columns.

In the chapel's construction, aluminum frames the glass curtain walls. The doors and the windows serve as facing for the interior plywood panels; these are held apart and the framing behind them is painted black. In the open bays a precise aluminum grid provides a pleasing contrast to the rough, unrubbed texture of the concrete, left unfinished as it came from the forms.

With imagination and skillful planning, architects Schweiker and Elting have successfully blended in the Samuel Tyndale Wilson Chapel their personal taste for warm, romantic proportioning and the contrasting cool, classic discipline that is the mark of modern American architecture.

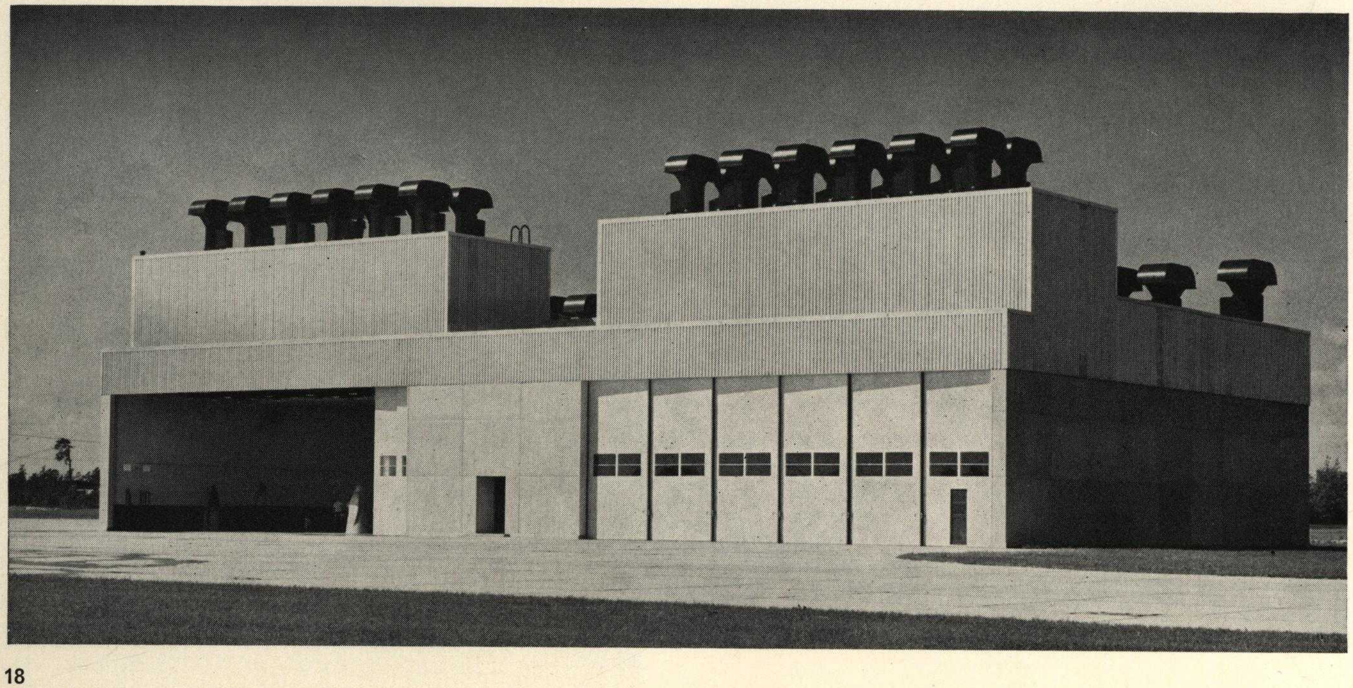


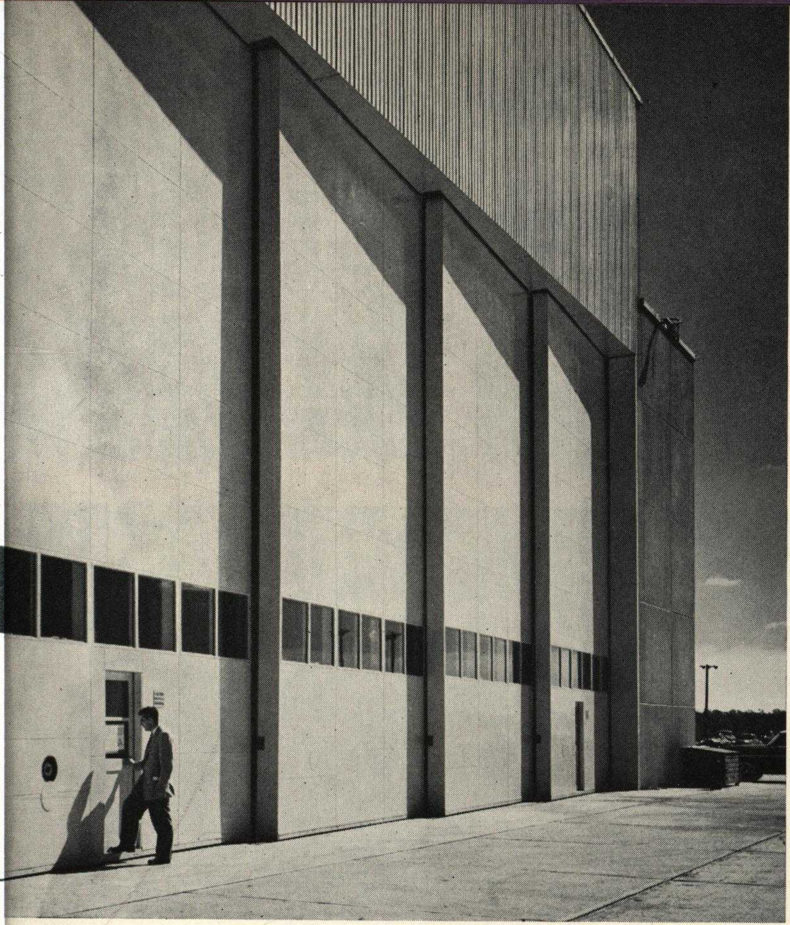
Left The modern classic entrance to the chapel building immediately establishes the ceremonial atmosphere of the "campus spiritual center." The careful proportions of the colonnade make the two-story building seem monumental. The tall aluminum-framed windows seen here in the open court that serves as the central lobby or outdoor hall of the building reemphasize the feeling of height and stateliness. **Right** Seen from inside, these same windows flood with sunlight the hall that ingeniously doubles as a theater foyer. Details like this are typical of a modern building that "works" with classic dignity.



Above These two hangars are part of Grumman's immense 4500-acre Long Island aircraft plant. Each hangar is 140 feet wide by 150 feet deep. The huge scale of the building can be judged by the automobiles parked alongside.

Below Paint shop is a first-rate example of modern American factory design. Black ventilating stacks, corrugated aluminum siding and precast reinforced concrete panels have been handled with unusual directness and skill.





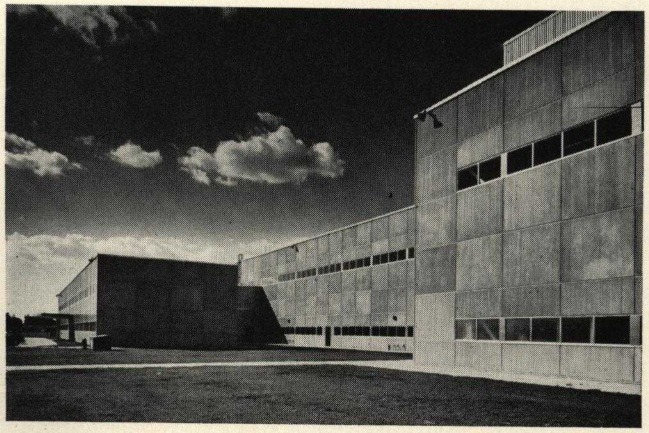
Aircraft Assembly Plant

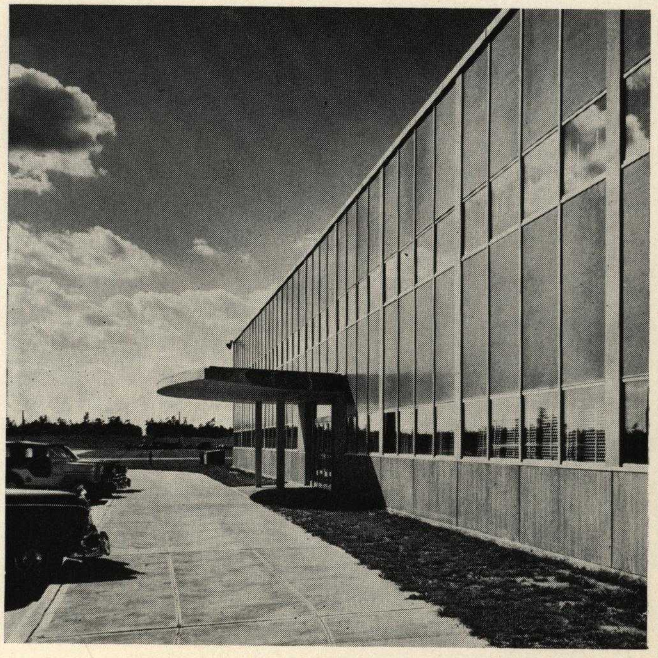
Calverton, New York, 1954

Alfred Easton Poor

Here is a superb example of a modern industrial complex — big but considerate. Because of its location in residential Long Island, N. Y., the reduction of noise was one of the main design problems. Thanks to Architect Alfred Easton Poor's ingenuity, this handsome plant is a model demonstration of the most effective and up-to-date techniques of architectural insulation. Aluminum windows throughout, installed only where daylight is important, are double glazed to exclude jet-testing noises. The sandwich walls, acoustic ceilings, deep floor carpeting and thick concrete roofing were selected for their special acoustic insulating properties.

Insulated aluminum is used in the upper portion of most of the buildings above concrete wall panels. Corrugated aluminum siding backed with insulation has been welded to the roof trusses. The widespread use of insulation for sound control has been economically combined with the reflective qualities of aluminum for protection from the sun's heat. This extensive use of aluminum building materials is typical of the aircraft industry. Like Grumman, many aircraft manufacturers first discovered in their planes the clean, lightweight, low maintenance properties of this modern material.



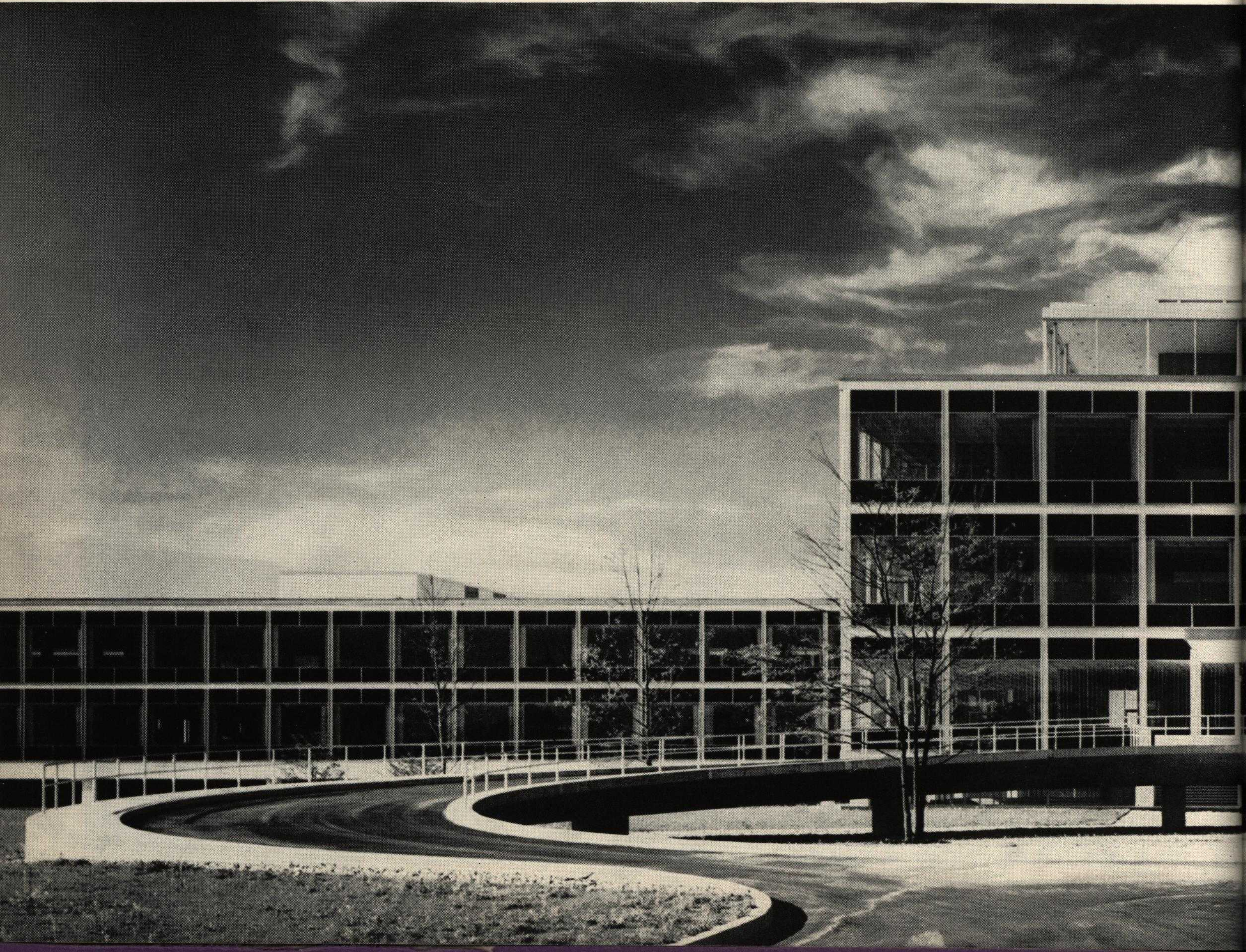


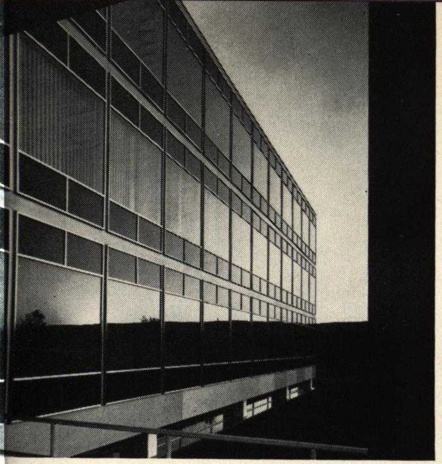
Top Hangar doors 36 feet high insulated for sound control, are so designed that they can be easily and quickly opened for the largest modern aircraft. **Above** The assembly and administration buildings show typical aluminum windows used throughout the plant. Because of jet noise, all fixed windows are double glazed. **Right** The administration building facade is constructed of prefabricated insulated anodized aluminum panels with galvanized steel backing installed between vertical mullions.

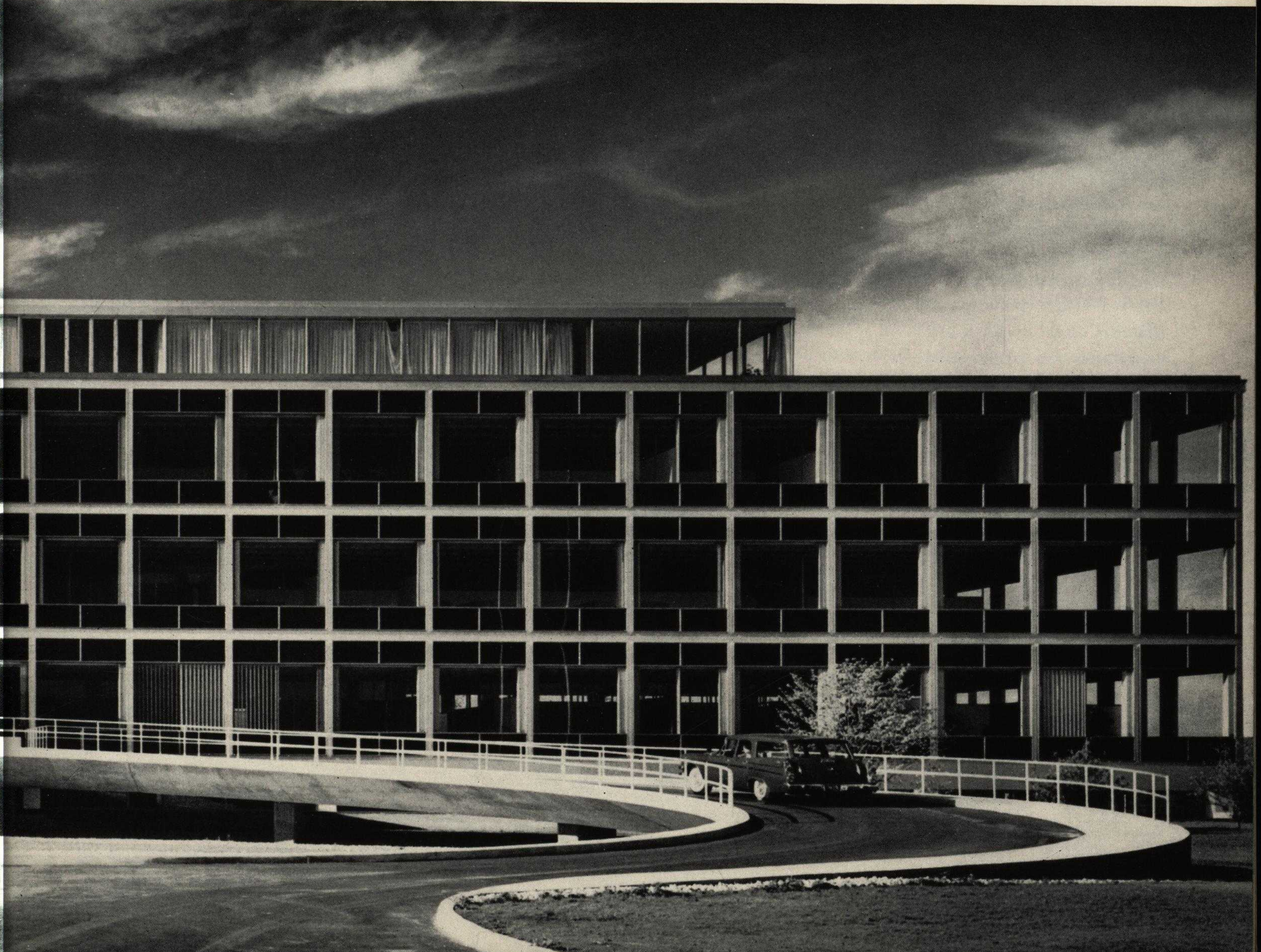
Connecticut General Life Insurance Company

Hartford, Connecticut, 1957
Skidmore, Owings and Merrill
William S. Brown
Gordon Bunshaft, Partner in Charge of Design

Right One glance at these photographs is enough to see why the American Institute of Architects, celebrating its centennial, selected Connecticut General as one of the "Ten Buildings in America's Future." A second look will show how this judgment is supported in every detail. The mirrorlike facade of the building reflects the rolling Connecticut countryside. **Middle Right** One of the four courts landscaped by sculptor Isamo Noguchi with gravel, grass, water, stone, flowers and trees. Landscaping has been related to the building with such skill that it is difficult to tell where architecture leaves off and landscape begins. Abundant modern sculpture is also related to both the building and the site in a superbly skilled manner. **Far Right** This evening view shows the west facade of the main building with its covered entrance. It also shows its relation to the Special Departments wing extending out on the north side of the main building. **Below** Looking south at the auto ramped north wing, you see a modern building that is beautiful in all its aspects.







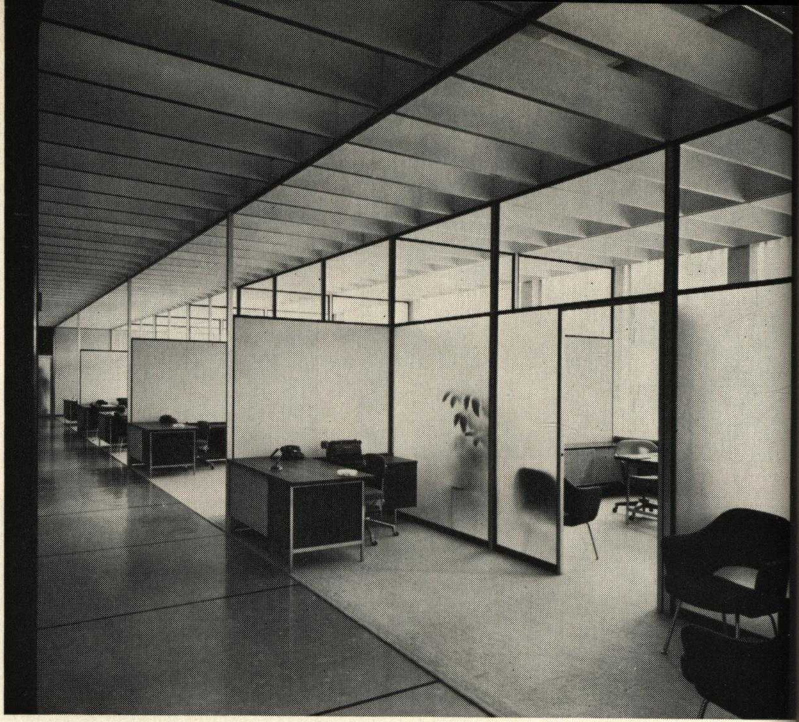
This dramatic office building looks good because it is good. The architect's superb design was the inspired development of the client's meticulous specifications. The fundamental needs were set up at the beginning after years of company research. The first fundamental was the prospect of further automation. This is the first building designed to make the fullest possible use of modern office technology. The second was a need for flexibility. The third was low maintenance. The fourth was the special character of the work environment. The fifth was expandability.

The great amount of aluminum used throughout the building was based on the manner in which this modern metal suited these specifications. As President Frasier B. Wilde commented, "Where reasonable initial investment in materials could cut down the yearly costs of cleaning, painting, repair and replacement, we made the investment."

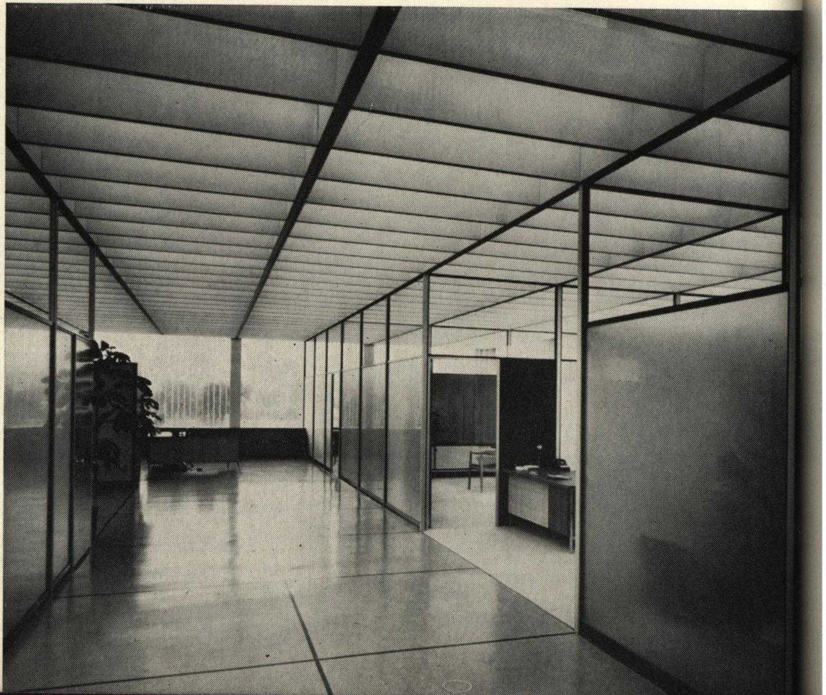
Connecticut General made its thoughtful investment in a building so huge that it is difficult to grasp from eye level photographs. The main block, for instance, contains 400,000 square feet of floor space unbroken by a single structural column. An employee cafeteria is cantilevered out over a reflecting pool at one side and a special departments wing is reached by a glass enclosed bridge at another.

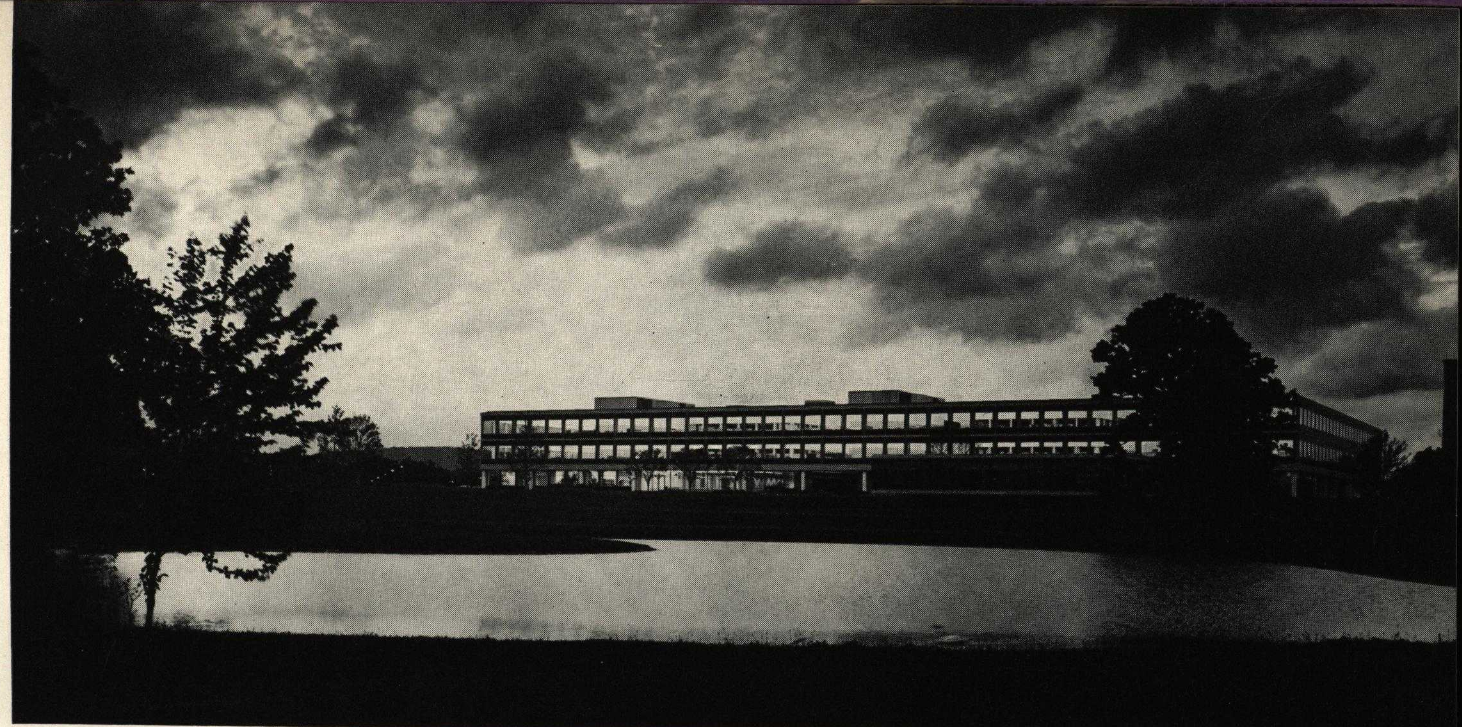
This building, for all its hilltop hugeness, is scaled to human size. It is in the details and the interrelated three-dimensional spaces that this architecture comes alive. The management deliberately chose to set a precedent in providing facilities for its employees — lounge, cafeteria, bowling alleys, beauty and barber shops. The designers refused to be satisfied with what had previously passed as refined detailing.

The anodized aluminum paneled glass walls with stainless steel trim and the elegant aluminum framed office partitions specially designed for the project promise to be widely adopted in an America that is looking for better ways to build.

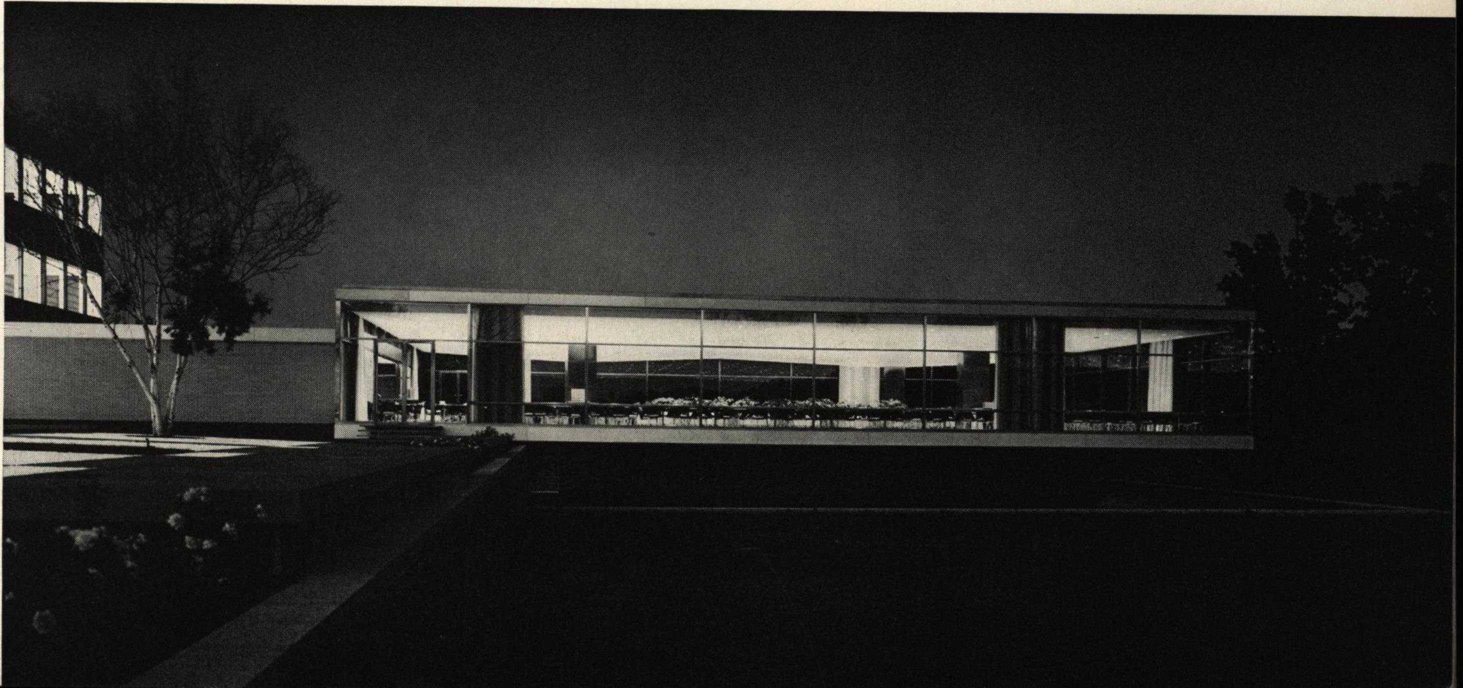


Above Interior office partitions like these were custom designed by Skidmore, Owings and Merrill and tailor-made for the Connecticut General Building. They have now been put into mass production under the name "C. G. Partitions." **Below** This view, like the one above, shows the trim relationship between the aluminum framed partitions, the grid ceiling, floor and modern office furniture. The two great work areas on the second and third floors of the building are unobstructed except for the cores which enclose the mechanical services. The moveable partitions were developed to provide perfect flexibility to the office layout.





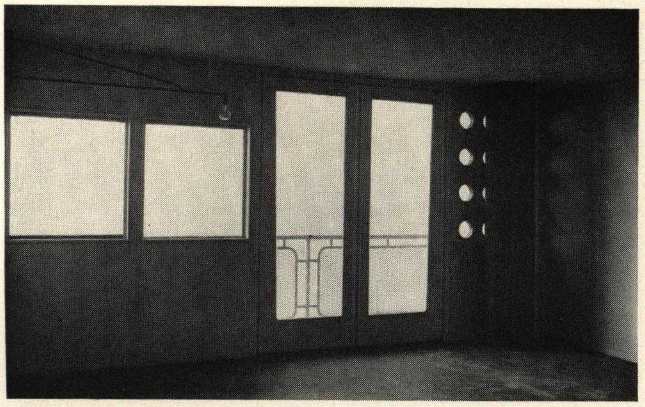
Above Here is the modern, efficient headquarters-in-the-country that the architects designed without destroying the rural beauty of the 208-acre country site. Even this pond, with its nearly 4,000,000-gallon water capacity, is utilized. It cools the water from the building's air-conditioning system without disturbing the wildlife swimming in it. **Below** The employee cafeteria extending out from the main building and overhanging a reflecting pool is one of the most beautiful parts of the building. This is especially appropriate in a work which to an unprecedented degree considers the human relations of the modern office worker.



Firemen's Barracks

Bordeaux, France, 1954

Claude Ferret

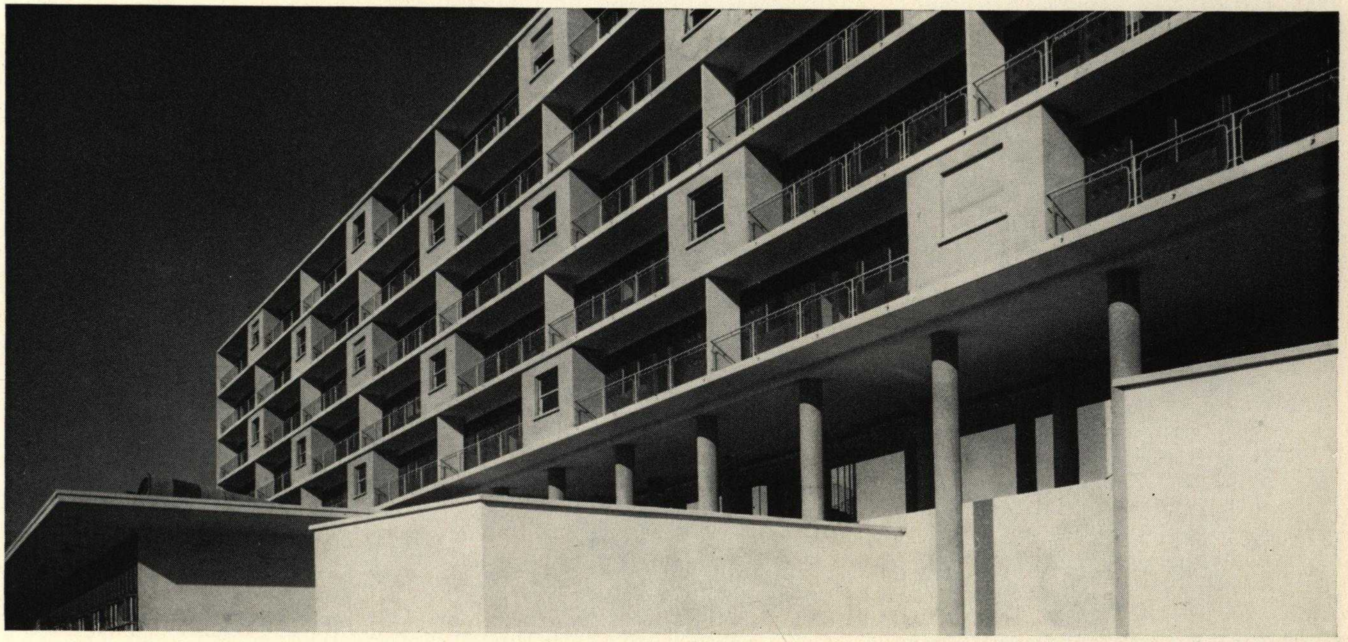


Few modern cities can match the municipal fire headquarters of the ancient French city of Bordeaux. The building, designed around a central practice yard, has a major-five-story unit of firehouse station and barracks with a two-story administrative office, guard post, first-aid station, dining hall, lecture rooms, infirmary, garage for fire engines, and workshops. A handsome white tower with six projecting red decks gives the firemen an opportunity to practice various techniques of fire control.

The building achieves a feeling of lightness from the fact that the supporting columns are exposed, thus avoiding the monolithic feeling engendered by the usual modern building form in which the curtain walls are carried down to the groundline. A double siding of insulated brick constitutes the northern and eastern facades. On the western and southern exposures, which face the river and are open to the prevailing winds and rain of the Bordeaux region, weather-resistant prefabricated aluminum sheeting is used for the facades.

Architect Claude Ferret's ingenuity and sense of design endowed this firemen's barracks with an unusual number of functional features plus an exceptionally good looking appearance.

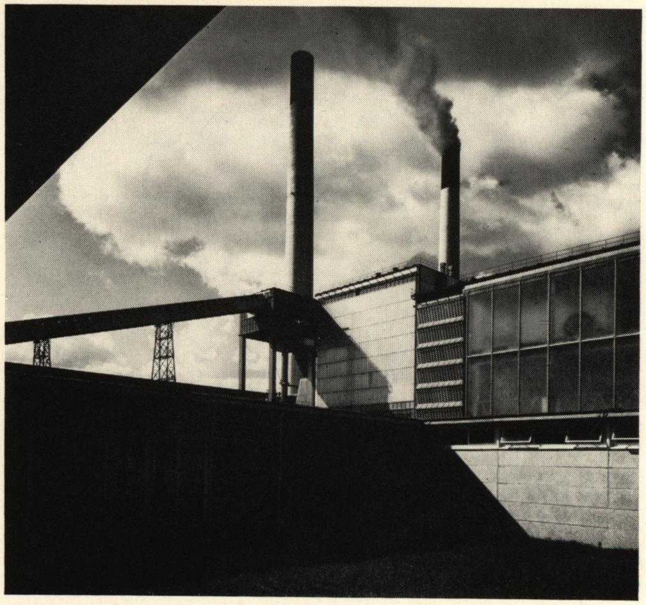
Left Garages where modern firefighting equipment stands ready to roll out through light, quick-opening doors. **Above** This typical fireman's living quarters shows the insulated aluminum window panels which form the western wall of the building. **Below** From the outside, the panels can be seen in relation to one another and to the balconies. The exterior finish of all panels is an appropriate fire-red, which provides a dramatic contrast to the white concrete used extensively throughout the structure.



Central Electricity Authority Power Station

Marchwood, England, 1956

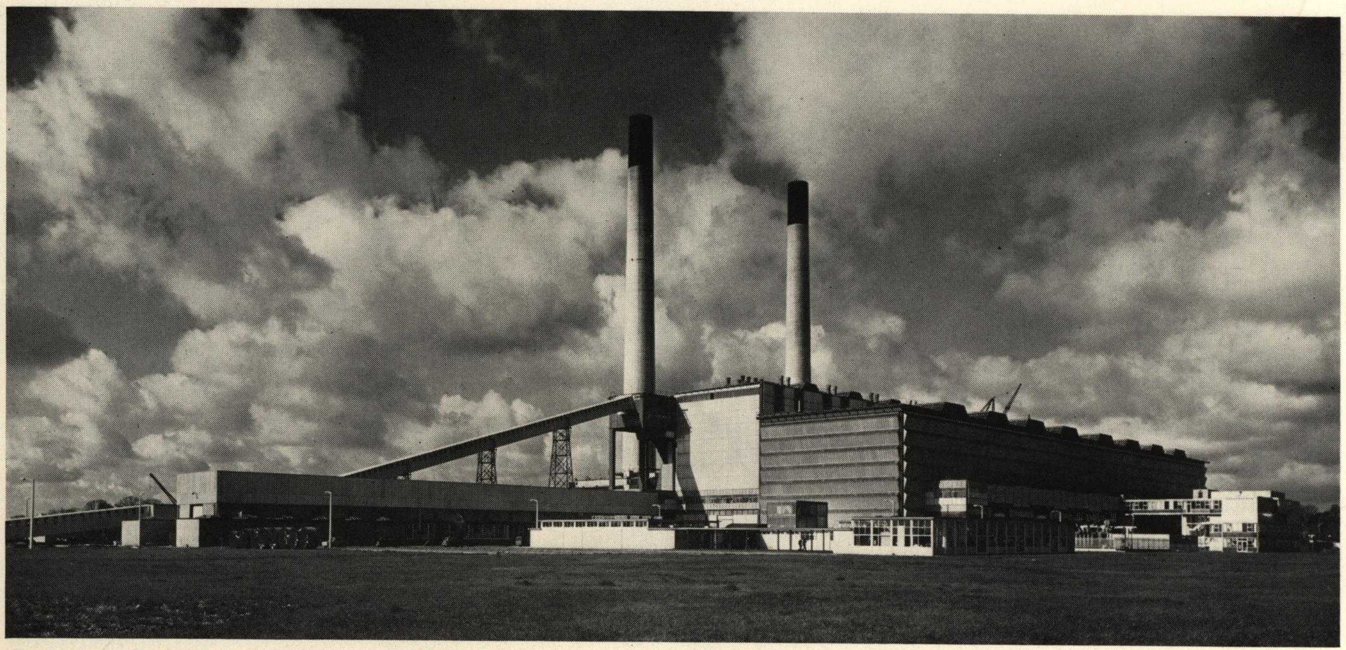
Frank Q. Farmer and Frankland Dark

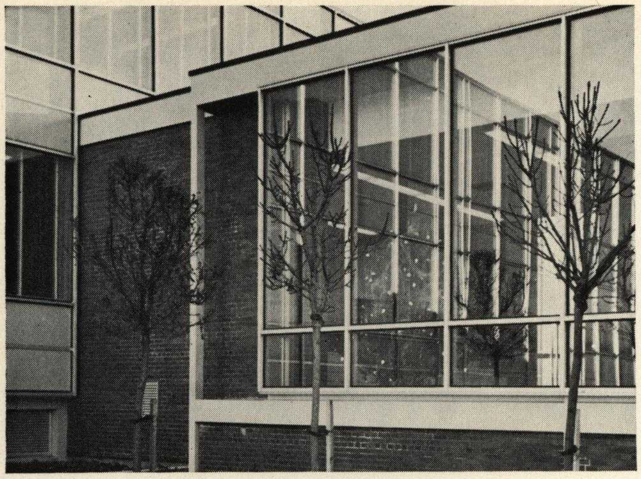


Power stations have a way of looking impressive even when poorly designed. The British Electricity Authority's Marchwood Plant is a celebrated example of how much more good architecture can contribute, not only in looks but in downright efficiency, to the housing of modern turbines. Farmer and Dark designed a steel framework on a module based on the power station's boiler dimensions. They also designed special pre-cast reinforced concrete blocks to meet requirements for a blast wall at low levels. Above this they employed aluminum curtain-wall construction in a manner and amount unprecedented in power station construction.

Altogether the boiler house, auxiliary boiler house, power house and auxiliary buildings use about 56 tons of aluminum extrusions, glazing bars, flashings and matting sheets, and about 25 tons of aluminum siding in various corrugated forms. Much of the savings, as well as the satisfaction with which the Marchwood station was received, has been attributed to "the adaptability, strength and pleasing appearance of aluminum, together with its tremendous advantage of lightness."

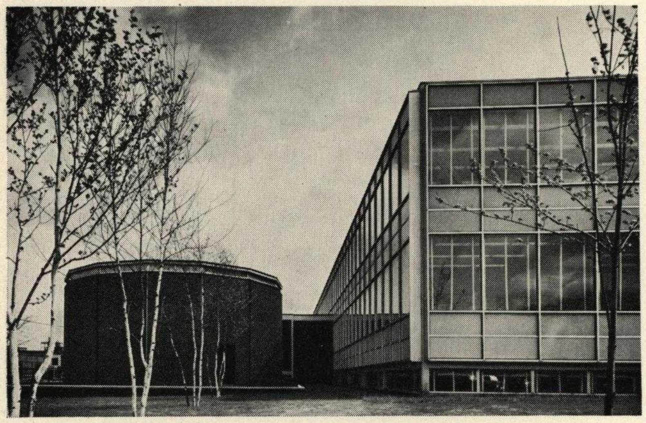
Above Brick smokestacks, aluminum, glass and steel-framed boiler hall with modular concrete base shows the principal materials of the project. **Right** For the upper part of the turbine hall, the architects developed an aluminum sheeting with glazing on the upper face. This vast venetian blind in conjunction with monitors gives an unexcelled distribution of light over the working areas without the slightest glare. **Below** *Overall view of the station from* the east reveals the skillful relation of the parts to the whole.





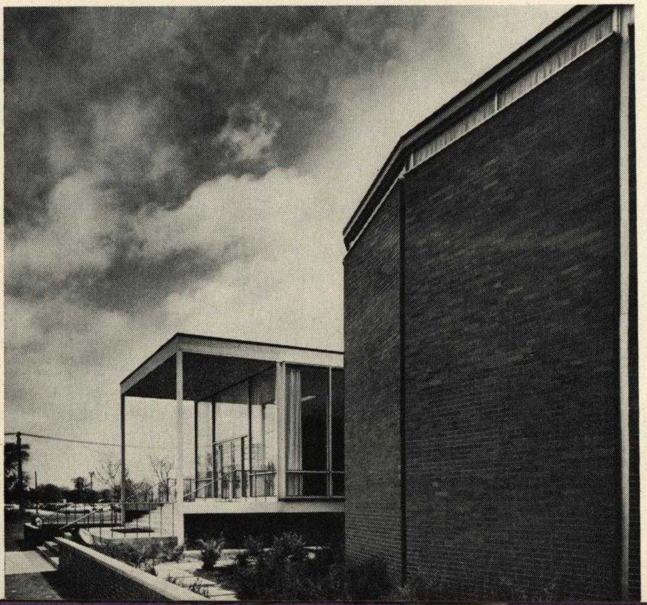
Office Building for Imperial Oil Division

Imperial Oil, Ltd.
Sarnia, Ontario, 1955
John B. Parkin Assoc.

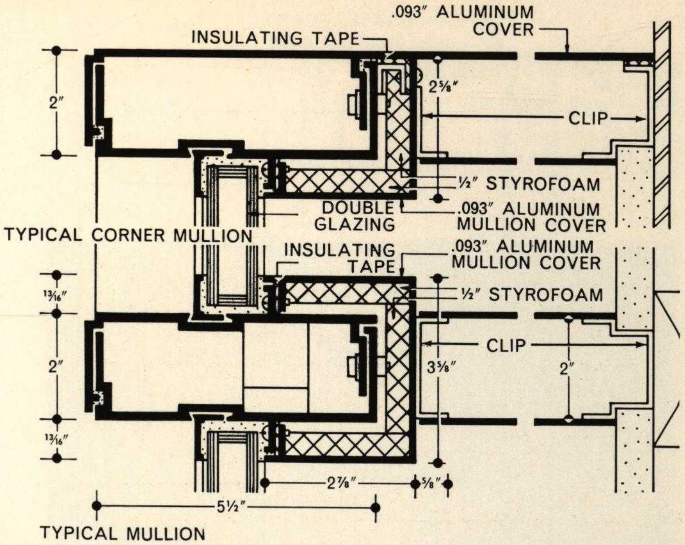


This engineering building looks as simple and as clean as a slide rule, and it is every bit as efficient. Dramatic contrasts in shapes, colors and materials give the structure an air of elegance as well as precision. The blue-grey aluminum and glass facaded office wing contrasts effectively with the rich purplish brick panels of the lecture hall; and the rectangularity of the main office building is offset by the fifteen-sided, roughly cylindrical form of the lecture hall.

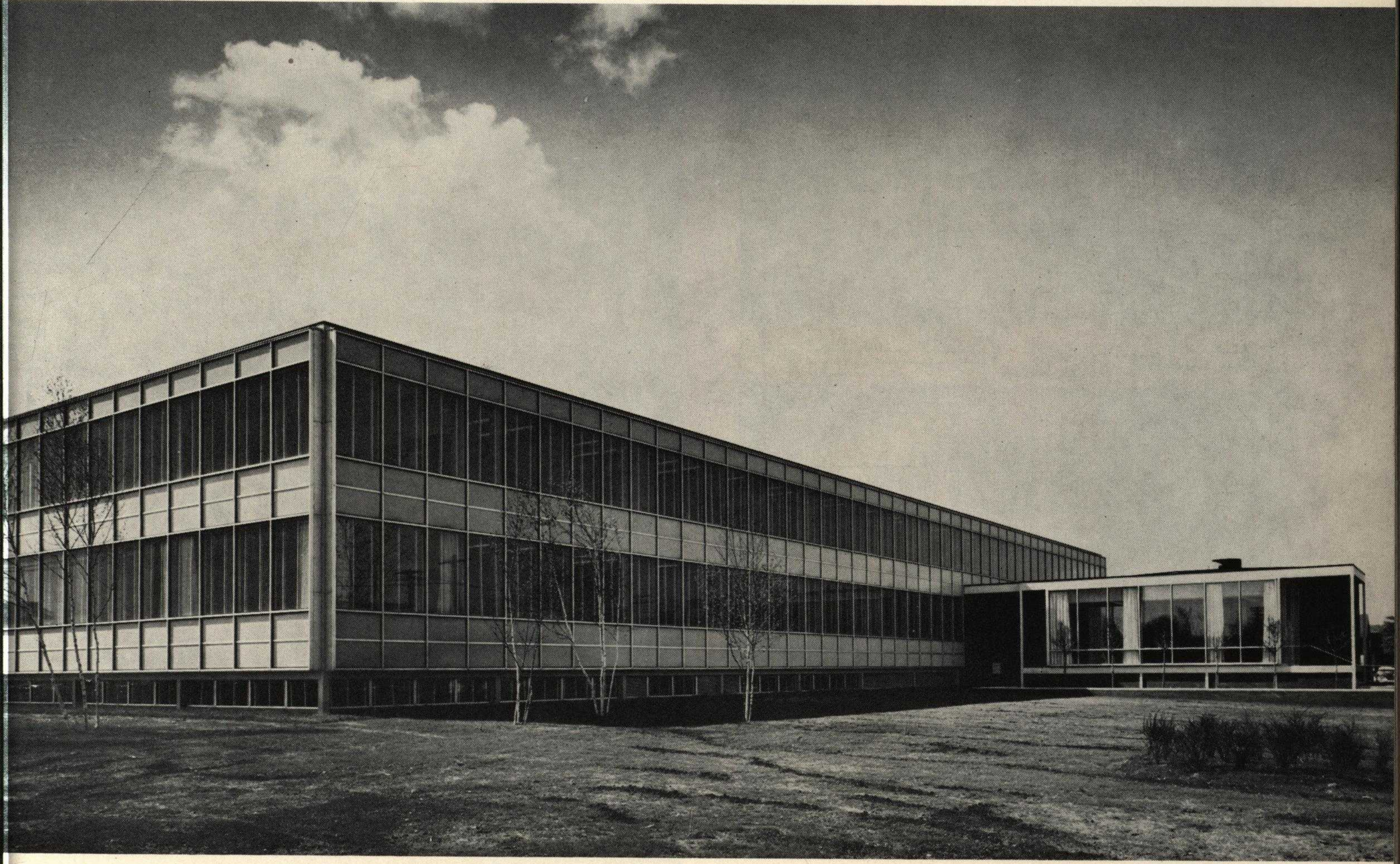
"Light weight, high insulation, lowest possible maintenance and deterioration, free choice of color, and shiny, clean, crisp finish" are the qualities that Architect John B. Parkin cites as his reasons for selecting the porcelain enameled aluminum spandrel panels. Along with the glass, they help the extruded anodized aluminum sections to form the skin of this striking building. The skin is completely double: the windows are double-plate-glass sealed units; the metal-faced prefabricated panels, themselves consisting of two aluminum sheets, are backed by an open air space and interior panels of woodchip concrete. Also double is the corridor scheme, which provides good natural light and a pleasant outlook to all private offices. This arrangement produced an attractive, long rectangular building, well suited to its narrow site.

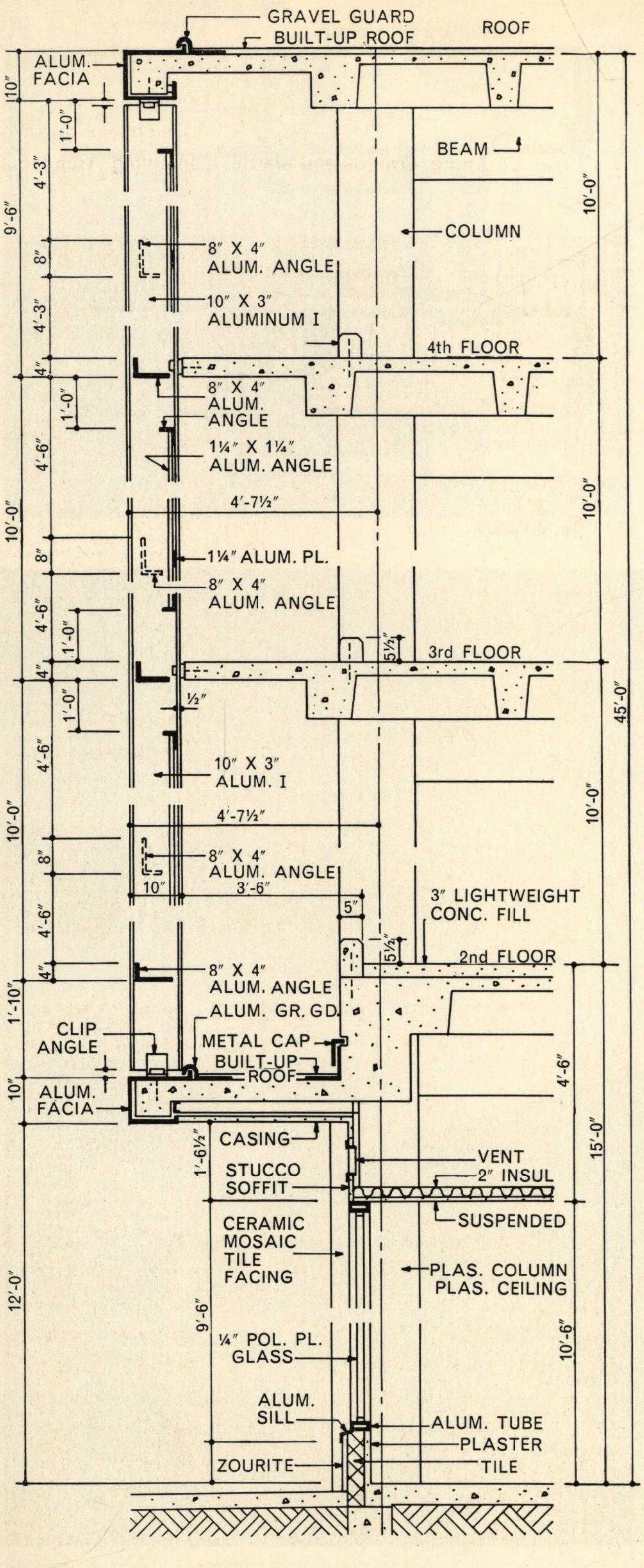


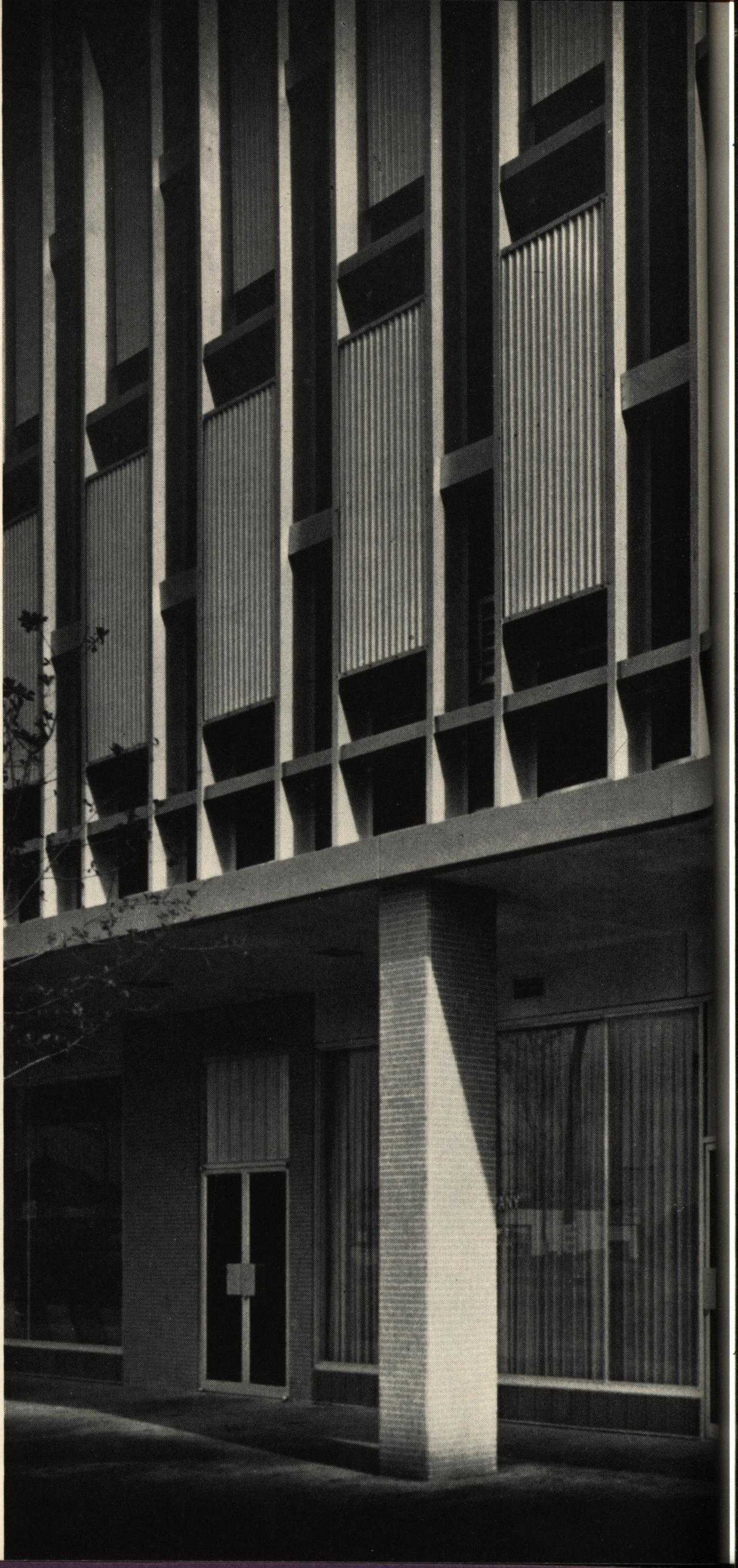
Top Close-up of the careful detailing of the entrance foyer which serves either the main building or the lecture hall. **Middle** Circular lecture hall of solid brick was built separate from the main building so it could be used independently by the staff of the refinery across the street. **Bottom** The sheltered main entrance is a particularly apt example of "the new structural look" characteristic of modern architecture.



Below All four sides of this engineering building are enclosed with a skin of clear glass and green porcelain enameled aluminum panels held in place by extruded aluminum sections. **Right** Detail drawing reveals construction.




GRAVEL GUARD
BUILT-UP ROOF
ROOF
ALUM. FACIA
10"
1'-0"
4'-3"
9'-6"
BEAM
10'-0"
COLUMN
8"
8" X 4" ALUM. ANGLE
10" X 3" ALUMINUM I
4'-3"
4th FLOOR
4"
8" X 4" ALUM. ANGLE
1'-0"
1¼" X 1¼" ALUM. ANGLE
4'-6"
4'-7½"
10'-0"
10'-0"
8"
1¼" ALUM. PL.
8" X 4" ALUM. ANGLE
4'-6"
1'-0"
5½"
3rd FLOOR
4"
1'-0"
½"
45'-0"
4'-6"
10" X 3" ALUM. I
4'-7½"
10'-0"
10'-0"
8"
8" X 4" ALUM. ANGLE
10"
3'-6"
5"
3" LIGHTWEIGHT CONC. FILL
4'-6"
5½"
2nd FLOOR
4"
8" X 4" ALUM. ANGLE
1'-10"
ALUM. GR. GD.
CLIP ANGLE
METAL CAP
BUILT-UP ROOF
10"
ALUM. FACIA
4'-6"
CASING
1'-6½"
VENT
2" INSUL
STUCCO SOFFIT
SUSPENDED
15'-0"
CERAMIC MOSAIC TILE FACING
PLAS. COLUMN
PLAS. CEILING
12'-0"
9'-6"
10'-6"
¼" POL. PL. GLASS
ALUM. SILL
ALUM. TUBE
PLASTER
ZOURITE
TILE



The Medical Towers

Houston, Texas, 1956

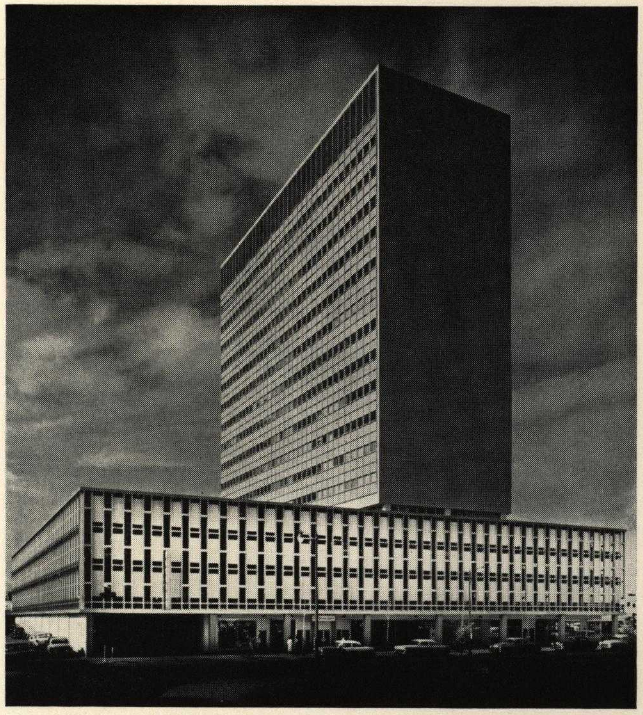
Golemon and Rolfe

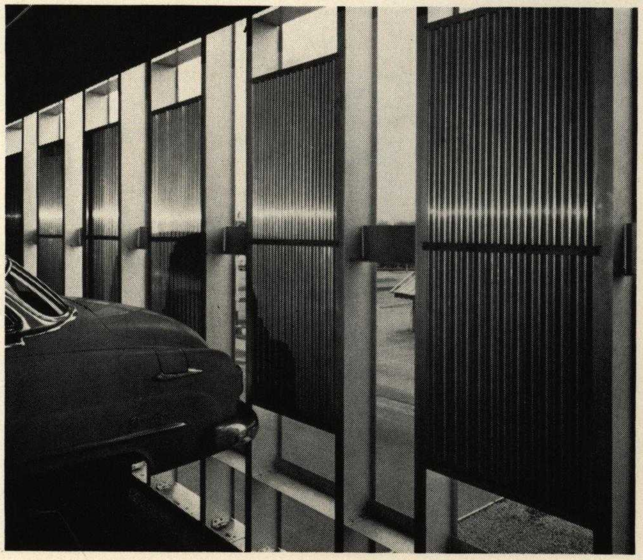
Skidmore, Owings and Merrill, Consulting Architects

This building, with its own built-in parking lot, received the AIA's 1957 National Award of Merit. Designed as a vertical eighteen-story tower rising from a four-story horizontal base, the structure makes a dramatic architectural contribution to a rapidly growing area five miles from Houston's downtown business district. Adjoining the Texas Medical Center and its six major hospitals, the building provides offices for one hundred twenty-five doctors and specialists. It also provides unusual conveniences for their patients.

Above the first floor of glazed shop facades and columns of aqua blue ceramic tile is a split-level garage screened from street view by an aluminum grille. Aluminum panels over the screening serve as windbreaks while performing their primary function which, according to the architects, is "to achieve the proper relationship of the solids and voids and still maintain a pattern compatible with the skin wall on the tower above." Architects Golemon and Rolfe extended this balance of solids and voids in their treatment of the tower's walls. The white brick of the solid loadbearing east and west walls balances the open, light, airy feeling of the northern and southern facades of glass and aqua porcelain enameled panels set in an aluminum grid. The aluminum framework is carried beyond the office floors to conceal the mechanical equipment in the penthouse, giving the tower a clean architectural appearance.

In Houston's Medical Towers aluminum has contributed to both the form and the function of a medical building planned for the automotive age.





Far Left Detail drawing of the building facade. **Left** The ground floor with aluminum-framed shop windows can be seen in relation to the aluminum grille that screens the upper-story parking area. **Above Right** It would be difficult to find a clearer illustration of form and function than this Medical Towers Building. The first floor, with its wide glass facade, is occupied by shops and stores. The second, third and fourth floors make a parking garage handling about 1800 cars daily. It enables doctor tenants and their patients "to park right in the building," which combines convenience with protection from the weather. The Tower's fifth through eighteenth floors are offices with window walls oriented north and south. The penthouse accommodating the mechanical equipment was skillfully designed to relate to the rest of the building.
Below Right The aluminum grille seen from inside the parking garage.

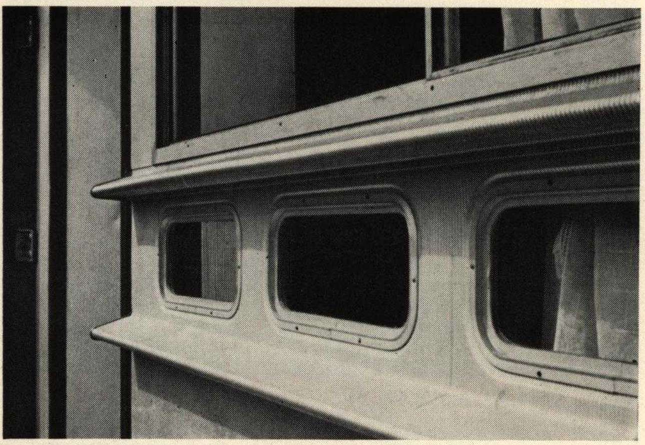
Apartment House

Saint-Jean de Maurienne, France

Prouve House

Nancy, France, 1955

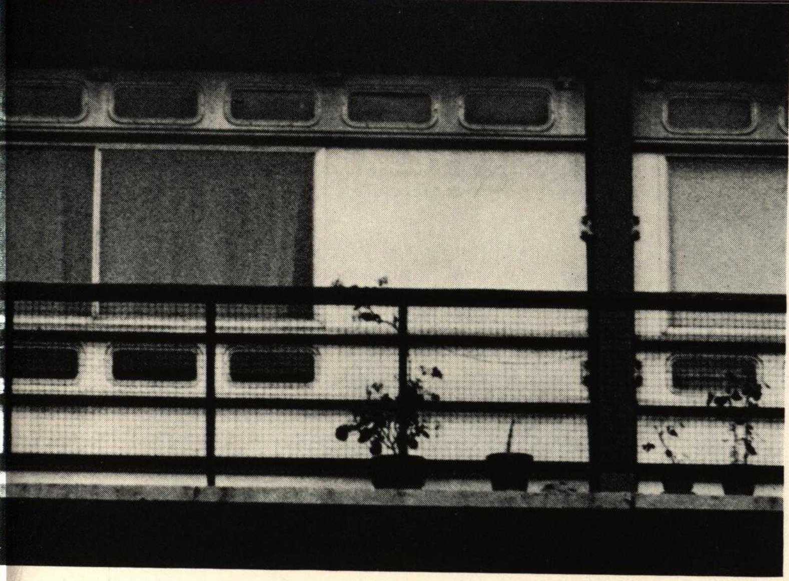
Jean Prouve



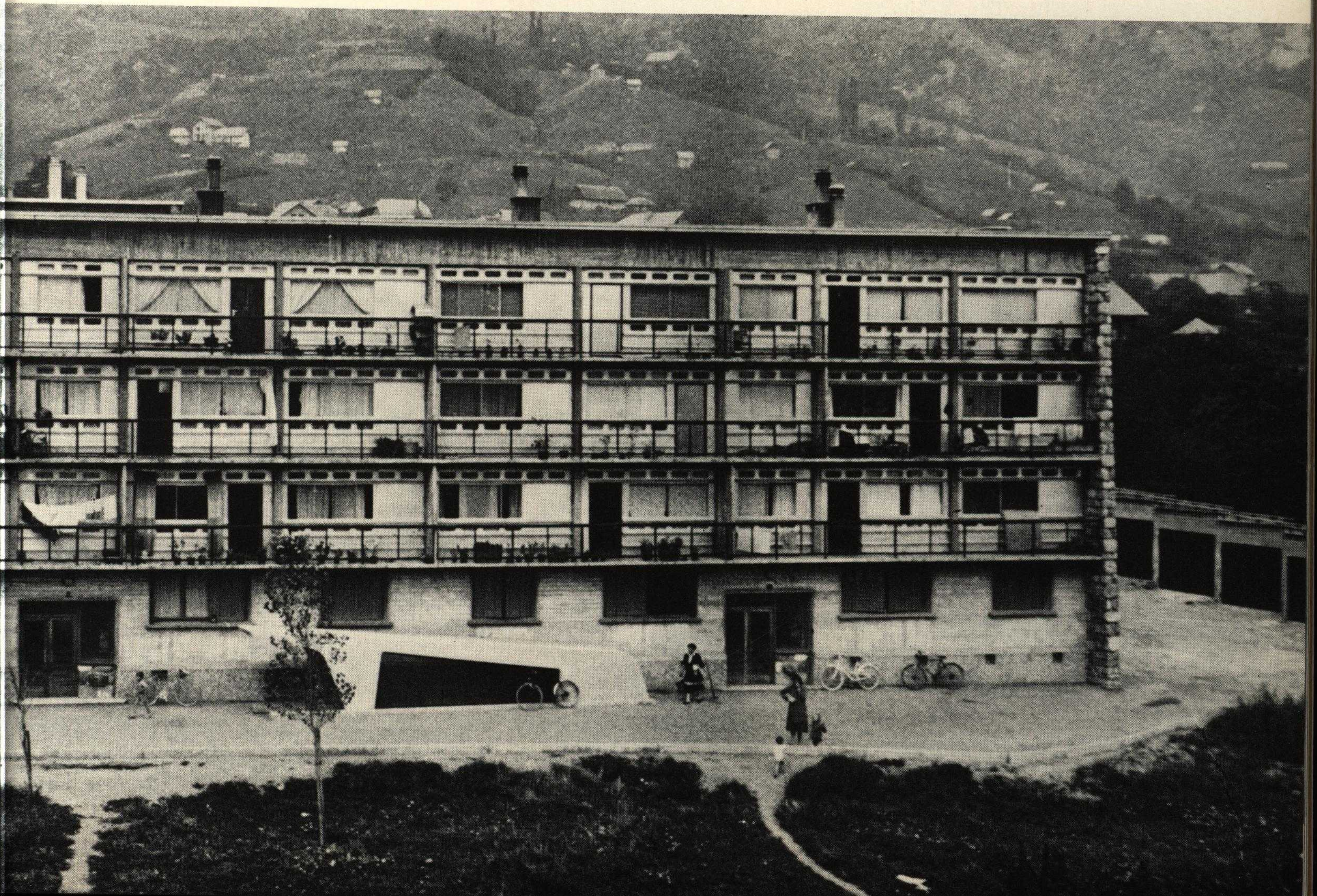
Above Close-up view of the Prouve panel with its characteristic ribs for stiffening and for space to receive the interior fastening. Also note the rounded vents so typical of his design.

Here are two structures that have a great deal in common. They are two of the buildings designed with the prefabricated architectural aluminum panels of the talented French architect-engineer, Jean Prouve.

Prouve, believing in the bright future of industrial components, is concerned not so much with a building as a building system. Convinced that metal was the basic material of mechanized mass production, he looked for a metal that was lightweight for shipping and erection, corrosion resistant and rustproof for low maintenance, with thermal values and easy workability. Prouve turned to aluminum and developed an aluminum panel. He



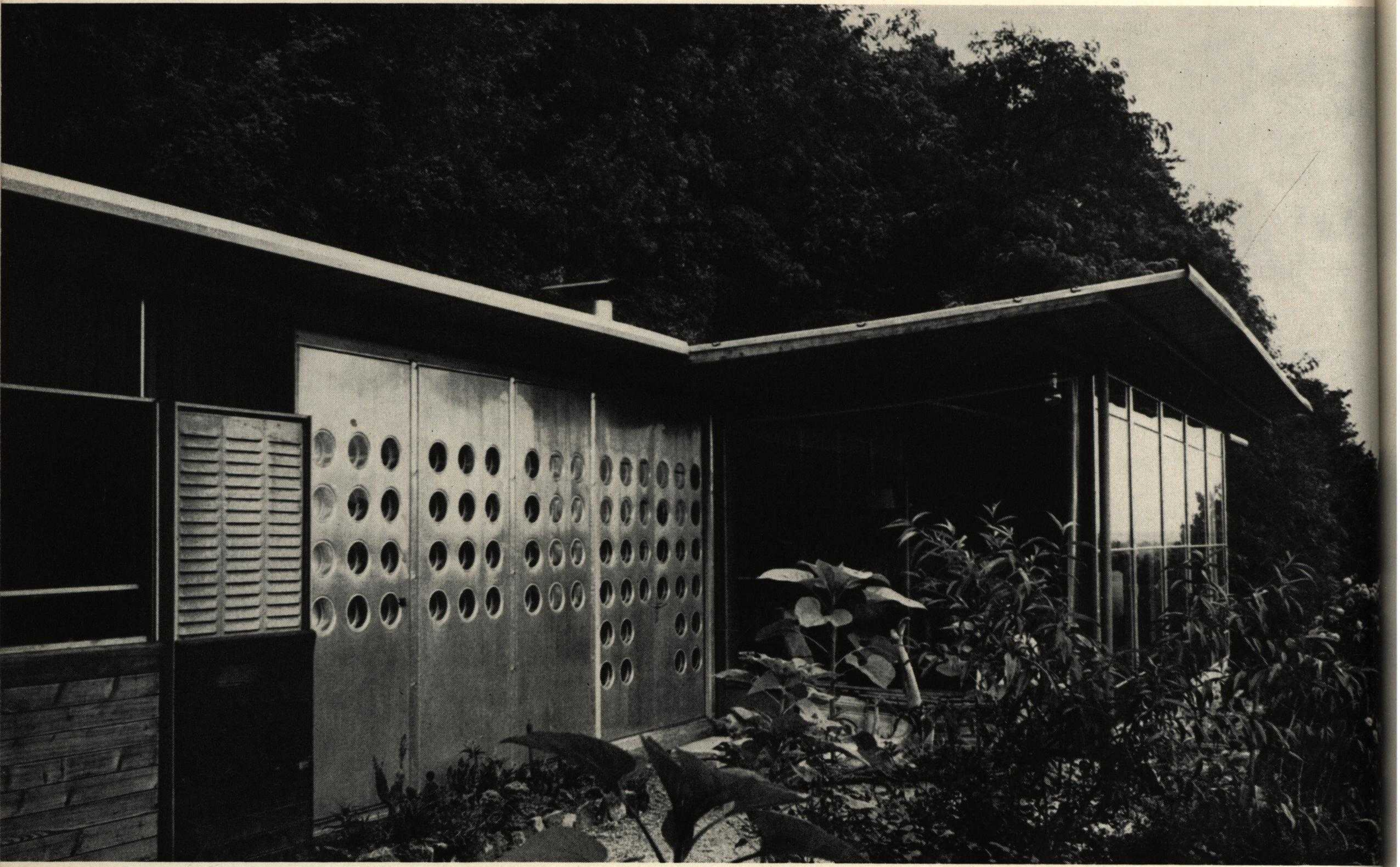
Left Here is a typical section of the apartment wall. **Below** In this building, the advanced Prouve panel demonstrates its easy affinity for the conventional continental apartment-house design and the regular European building materials. This unusual ability to escape the extra-mechanical look of machine-made components and to preserve a human quality is one of the hallmarks of the architect's work.

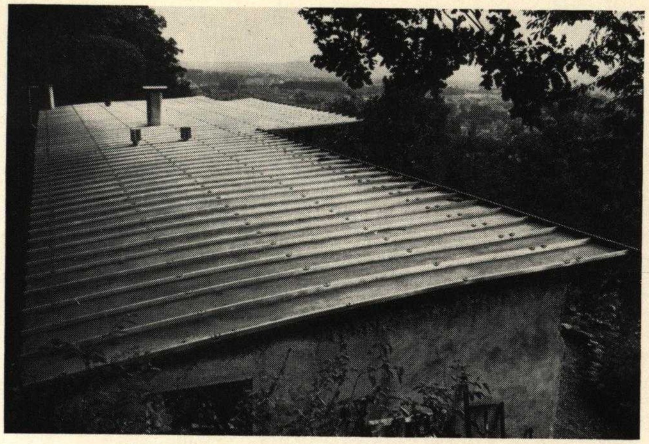


designed panels with various apertures — doors, windows, vents, etc. In Prouve's system, the windows are not put into the wall, they are simply wall panels with a certain area of glass substituted for a certain area of aluminum.

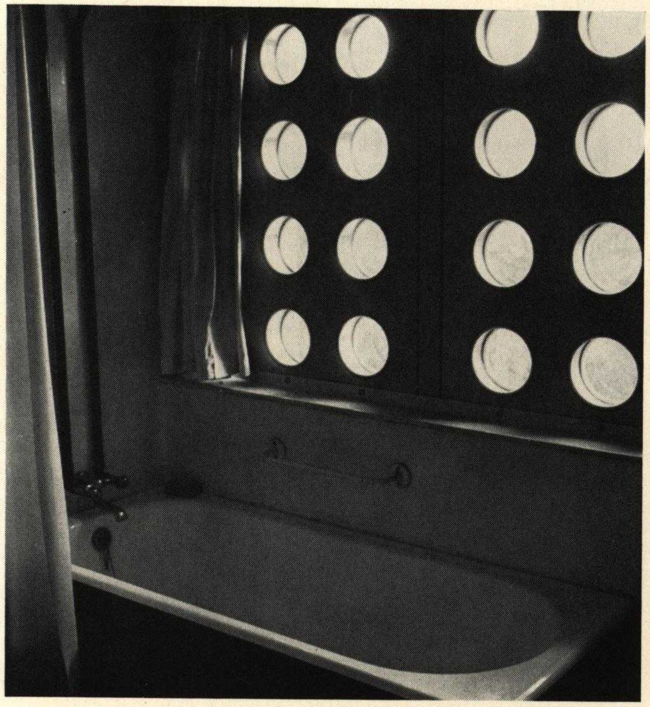
His basic panel system is simple although it is produced with astounding variety. It has three principal parts: two ribbed aluminum sheets for the outer and inner wall and an aluminum clasp, either cast or stamped, that holds the two panels together with a cavity between them. The two sheet surfaces have insulation material placed between them before assembly.

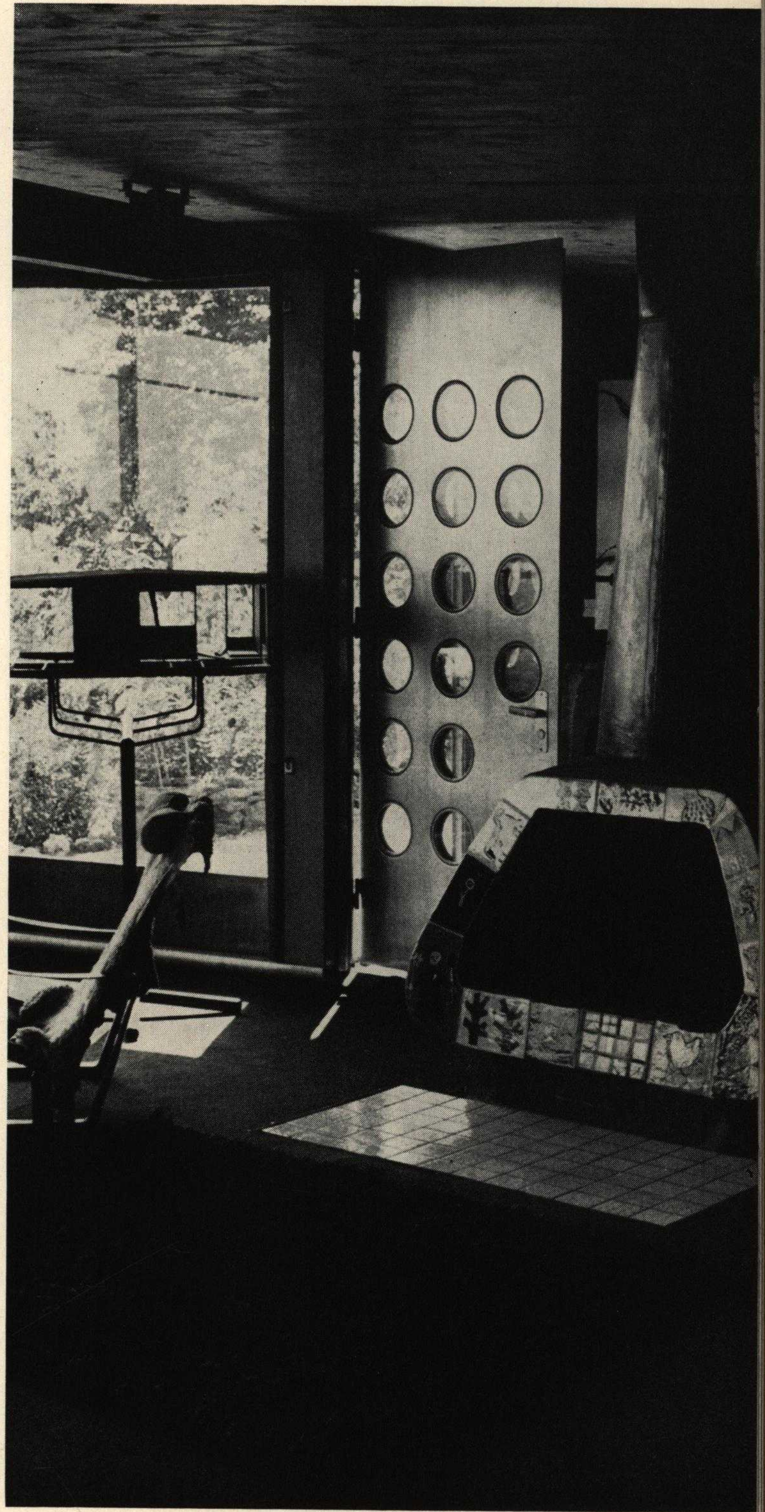
Opinions may differ about the architectural elegance of some of Jean Prouve's buildings but there is wide agreement that his lightweight panel system is making a significant contribution to the architecture of the future.





Above The lightweight aluminum roof of Prouve's own house in Nancy. **Left** The panels are here combined with conventional wood siding on the left and modern aluminum window walls on the right. While Prouve believes in the future of buildings made only of prefabricated panels, and in fact has designed such a skyscraper, he demonstrates that they can also be used along with familair building materials. **Right** The living room features a panel door and a prefabricated fireplace. **Below** In the bathroom the rustproof aluminum panel displays not only its spotlessness but its ability to withstand moisture. The round vents derive from the nature of the metal and the mass production methods of working it, rather than from any effort to make the work look like a building of the future.

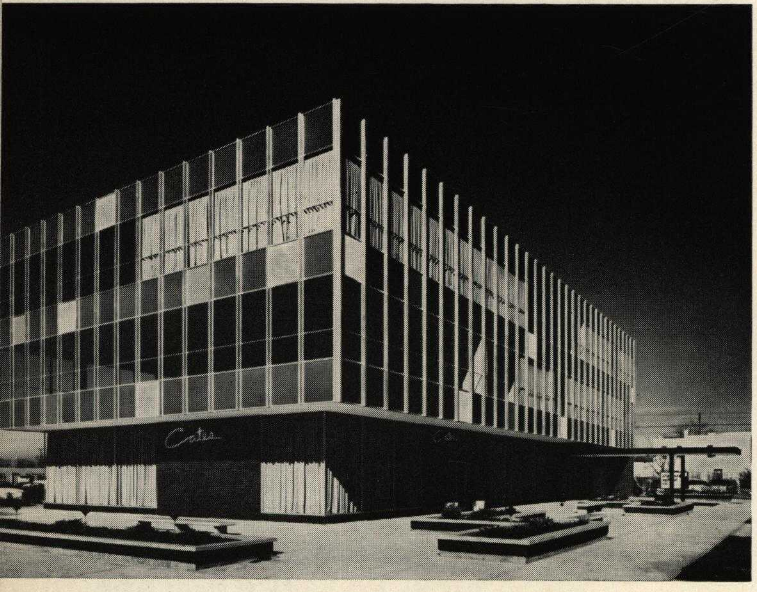


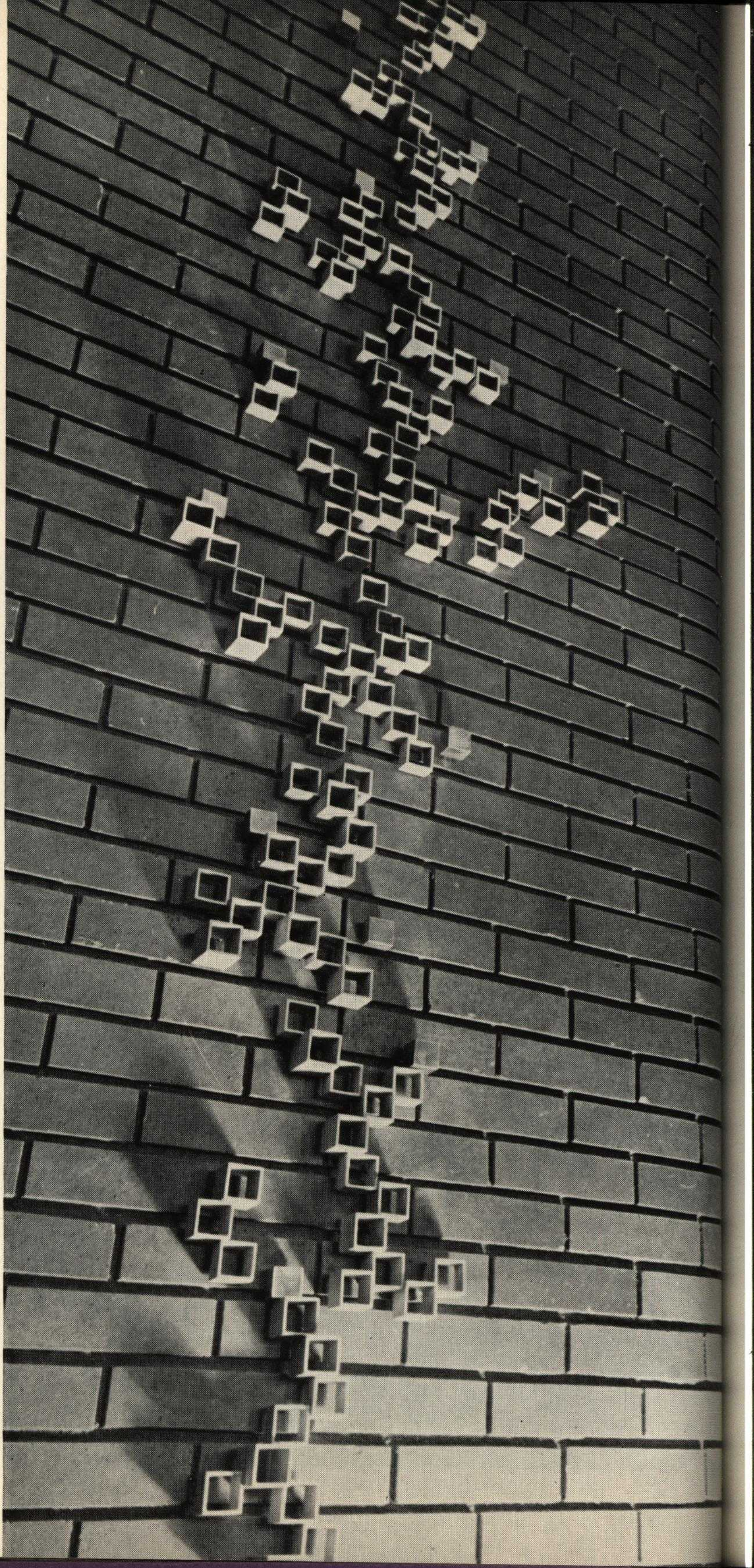


Redding-Miller Building

Denver, Colorado, 1956

Theodore J. Moore, Jr.





This is a small building with big-building styling. Its porcelain enamel spandrels in bright colors across the glass and aluminum facade make it an admitted eye-catcher. Planting areas with bright flowers and benches for the pedestrian have been carefully related to the architecture. On a site three miles from downtown Denver, it stands out in sharp modern contrast to nearby brick-style architecture.

Architect Moore thinks its really outstanding feature is its low-velocity baseboard air-conditioning system with special diffusers integrated into the curtain wall. The client, Redding-Miller Corporation, Denver's energetic real estate investors, thinks it is the price — which, including all improvements, worked out to a low $15.00 per square foot.

Above Seen from the street, the aluminum and glass box seems to float on a base of brick and window glass. The porcelain enamel wall panels are bright red, yellow, blue and white. **Right** This modern abstract wall decoration in the main stairwell was imaginatively designed of short sections of square aluminum tubing.

Columbine Building

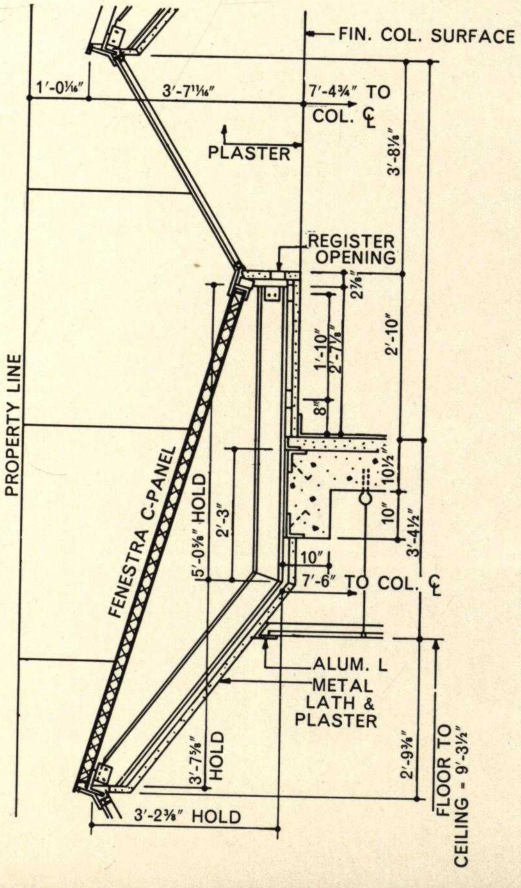
Denver, Colorado, 1954

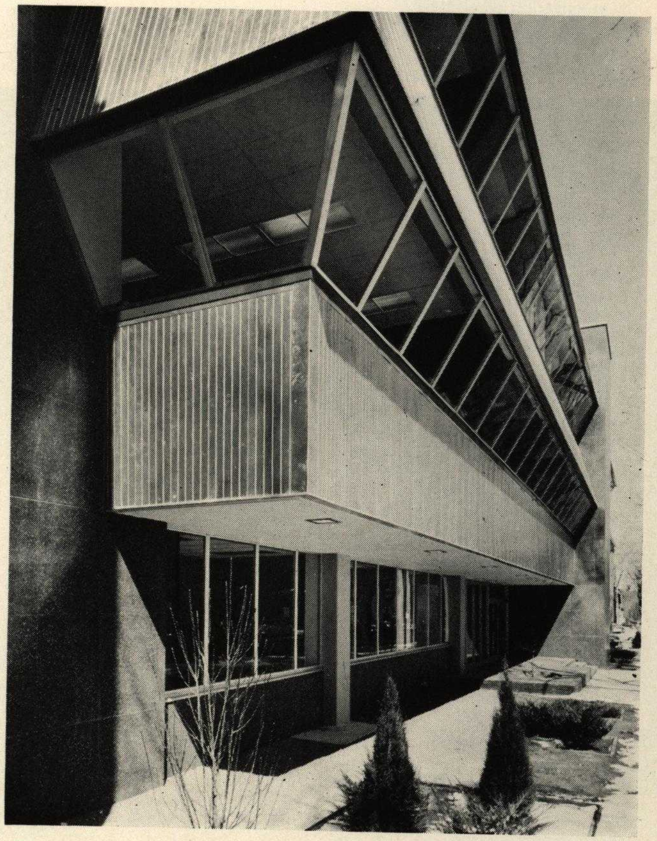
James S. Sudler

The Columbine Building represents a new angle on sun control. By slanting the exterior wall against the sun, rather than using the more conventional louver system of shading, architect James S. Sudler integrates sun control into the outside structural walls.

Angled against the sun, the aluminum panel walls and windows in the two top floors act as a natural sunshade. The glass itself has a shading effect as the sun's rays pass through the windows at a 31° angle.

This structure is distinguished by its extreme adaptability. The secret of the flexibility of interior partitions, ceilings, lighting, air conditioning and electrical conveniences is a four-inch grid floor plan. Named after the handsome state flower, the design excellence of Denver's Columbine Building marks a significant contribution to the increasing efficiency of modern air conditioning by providing built-in shade.



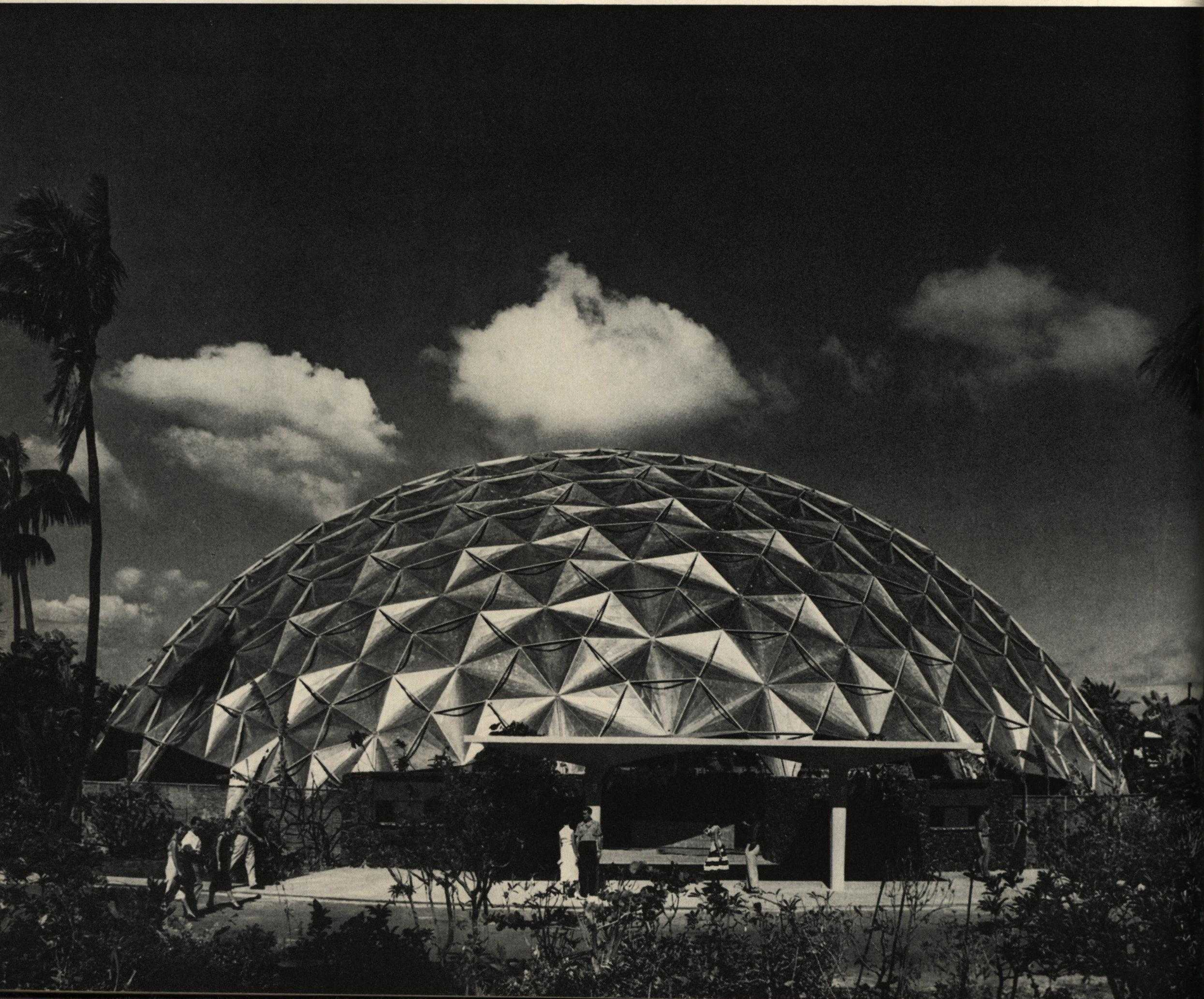


Above The most striking feature of this Denver office building is the ingenious sloping aluminum panel walls and windows. The shade-making angles of the exterior wall not only make the individual offices easier to air condition but make them seem more spacious inside. **Left** The drawing details wall construction. This was one of the first office buildings to employ metal exterior walls without masonry backing.

Auditorium for Hawaiian Village Hotel

Honolulu, Hawaii, T.H., 1957

Don La Rue, Engineer

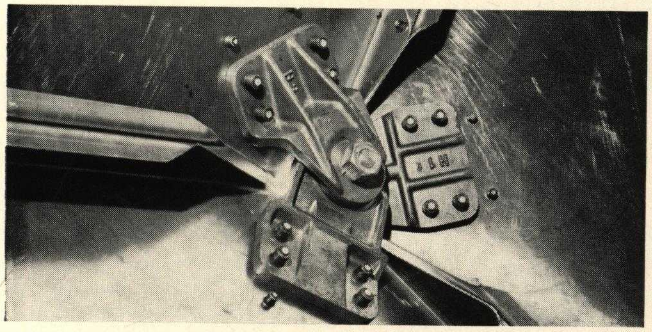


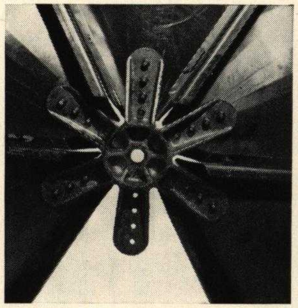
Left Dramatic and different, this all-aluminum dome applied modern aircraft construction techniques to an auditorium in Hawaiian Village, Hawaii.

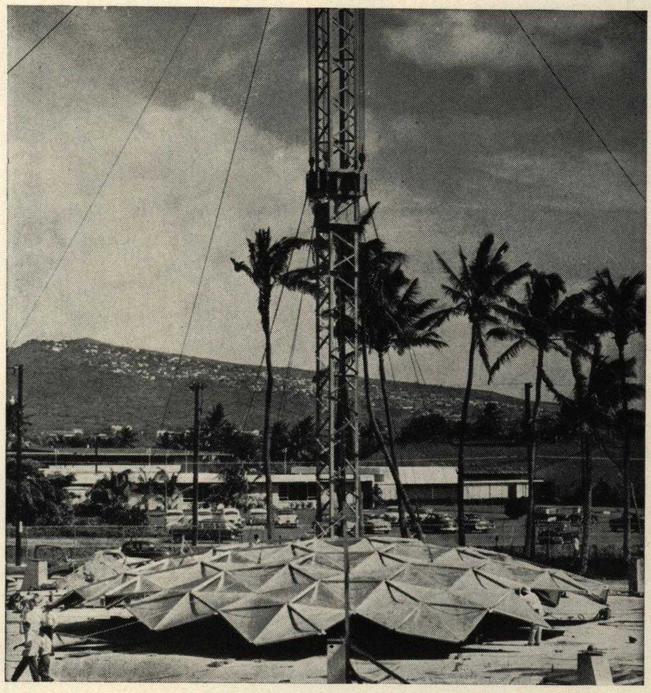
Below Three close-up photographs show the hub castings, strut bracings and star-shaped castings which hold the skin tight and firm.

Above Workmen lift diamond-shaped panels into place. Each panel was color coded to speed construction. Dome was put up in 20 working hours.

Below The dome begins on the ground. Additional panels are attached as crest is hoisted up mast. When dome reaches full height, mast is removed.



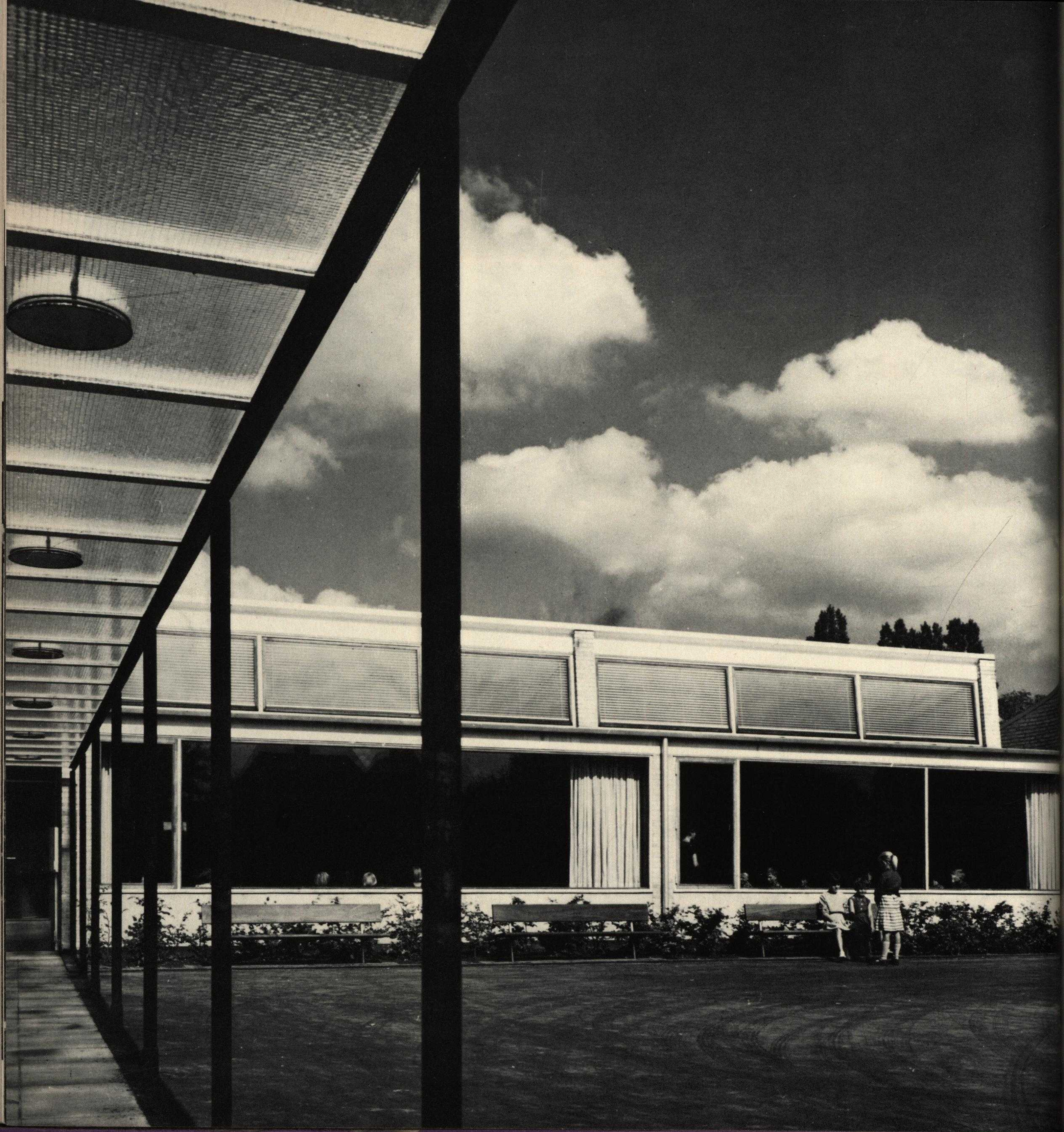




To those familiar with the free-wheeling, imaginative works of Buckminster Fuller, this pineapple-like dome might look familar, perhaps even conventional. Yet this aluminum auditorium is unique, the first structure of its kind ever erected.

Located in Honolulu, the building — which accommodates more than 1800 persons — was designed as an auditorium to be used for conventions and entertainment at Henry J. Kaiser's Hawaiian Village Hotel. Steel in stress is the standard practice, but in this experimental shell structure Engineer Don La Rue has succeeded in designing an all-aluminum stressed-skin dome. It eliminates pillars or any other interior supports and provides a maximum of usable space with a minimum of materials. La Rue's success can be measured by the fact that this clear span structure can withstand loads of more than 100 pounds per square foot and can resist the wind pressures of a major hurricane.

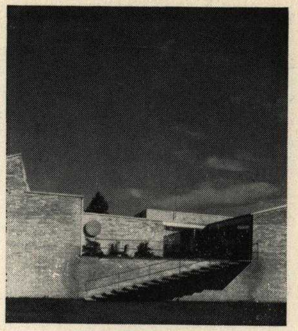
The result of this engineering experiment is both practical and dramatic — a lightweight, quickly erected, moderately priced structure that is both big and beautiful.



Munkegardsskolen Elementary School

Vangede, Denmark

Arne Jacobsen, 1955



This celebrated Danish school begins where others stop — out of doors.

Architect Arne Jacobsen has opened the identical classrooms onto ten courts, each uniquely planned and delightfully landscaped. By providing every two rooms with a shared yard or garden, the intimate atmosphere of a small school is preserved in a city school for more than 1200 children.

The interior walls and bearing partitions are of untreated yellow brick cavity, the partitions being sand-filled for sound insulation. The roof is constructed of thick aluminum sheets lined with roofing felt. Organized in an unusual finger system, the overall plan called for corridors crossing instead of paralleling the one-story wing.

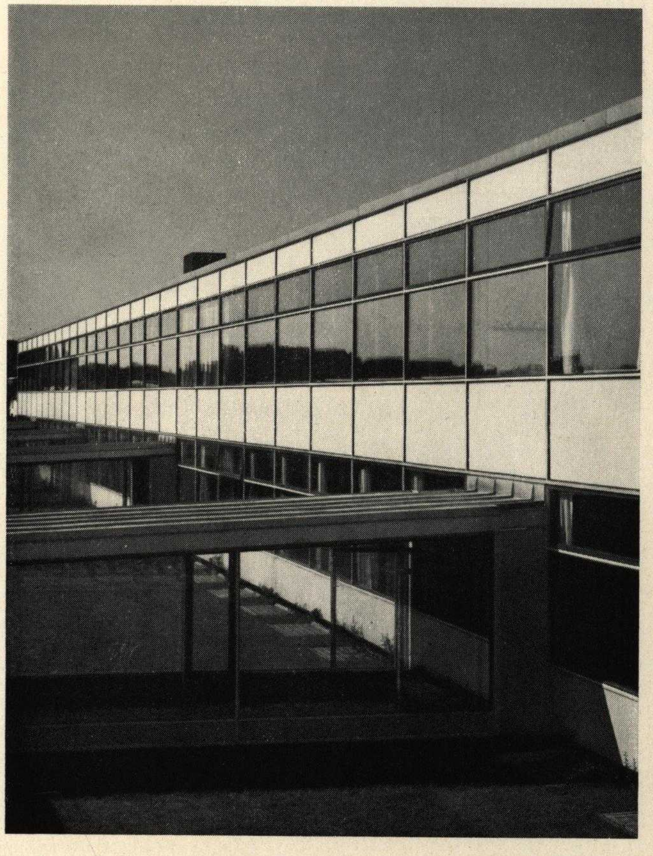
To the north is a two-story building for special subjects, such as the natural sciences and manual training. Centrally located is the auditorium with its stage. On the west the school is provided with two gymnasiums located in a separate building; on the east a two-story building contains a playground and other recreation facilities for the youngest children. Another two-story wing houses the administrative offices.

To give individuality to the courtyards, and by extension to the classrooms, Jacobsen has designed the court pavements in a variety of interesting geometric patterns. A glass-enclosed walk extending from the entrance to the gymnasium faces the large central courtyard.

This complex of structures and courtyards provides an environment conducive to learning and community living, and instills an appreciation of natural surroundings. The creation of a world-renowned architect, here is a school suited to the spirit as well as the studies of children.

Left This covered walk roofed with reinforced glass leads to one of the main entrances of the school. In this unusual fingertype plan, corridors cross to provide each classroom with a courtyard and a sense of intimacy.

Above Left Each inner court is handled differently by means of an artful arrangement of paving, flowers and trees. Some have small pools. This particular one has a piece of sculpture. **Above Right** View from the playground shows the bricked side wall of the double gymnasium for boys and girls. Large play areas and exterior walks are maintained as beautifully as the inner courts. A special area of about a hundred small garden plots has been provided for horticultural instruction. **Below** The two-story special subjects wing has a light metal wall with careful elegant detailing, characteristic of Jacobsen's simple refined style. Continuous windows and skylights flood all the classrooms with an abundance of light.



Vapor Factory

Breukelen, Holland, 1956

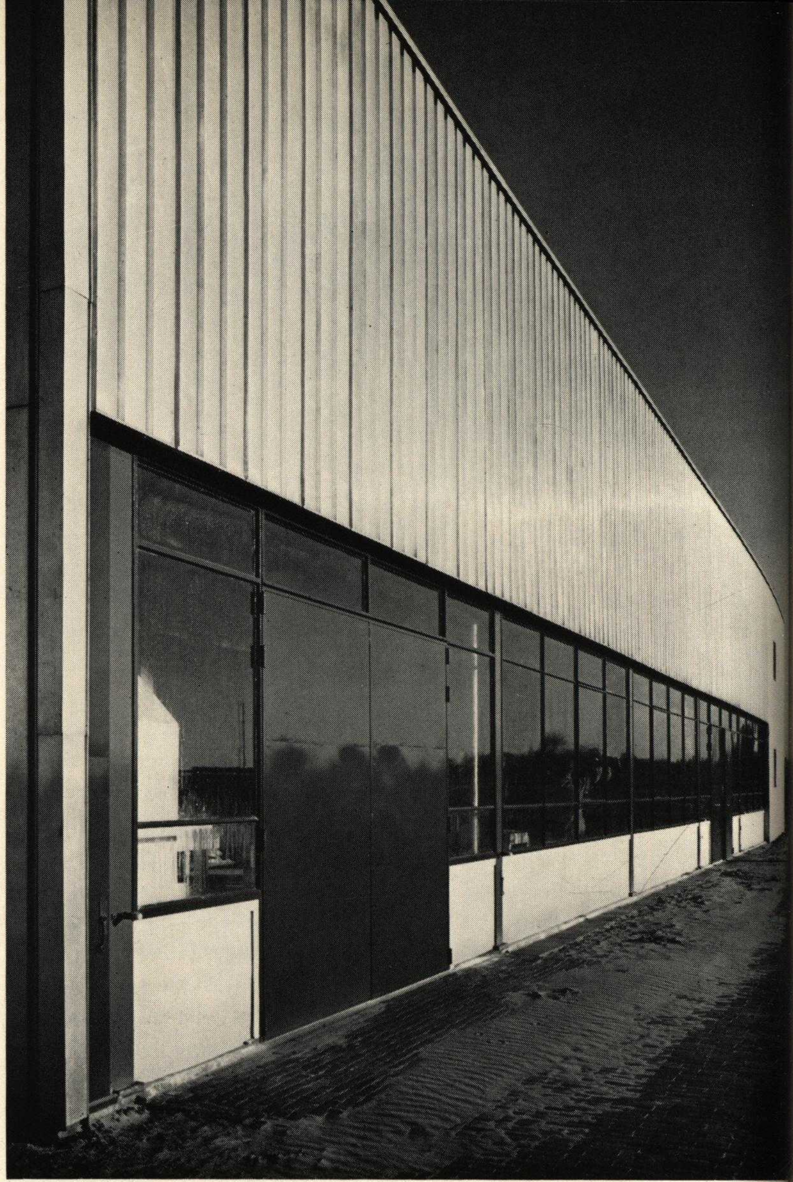
J. J. van der Linden

The cornerstone of this factory in the Dutch town of Breukelen was appropriately laid on June 11, 1956, the 310th anniversary of the founding of the American town that adopted its name — Brooklyn, New York. Built for a U. S. firm manufacturing products for the European market, the plant neatly combines characteristic features of both contemporary American and Dutch architecture.

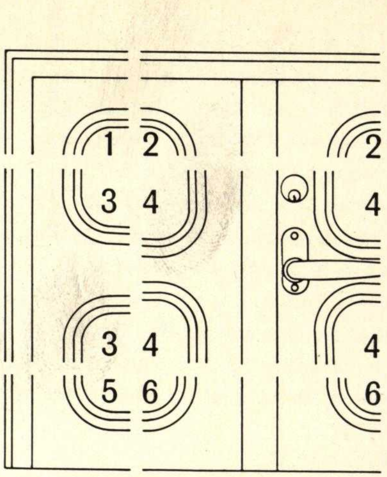
The office wing, with rooms for the administration, engineers, a showroom and a canteen, is constructed of typical Dutch building materials — concrete and brick.

To facilitate future expansion, the plant utilizes the flexibility of design that marks modern American factories. A serious problem arose when it was discovered that the soil beneath the plant site was not satisfactory for standard factory construction. The site, however, was excellently located near a modern four-lane highway, the Amsterdam-Rhine Canal, and a major railway. After careful research, architect J. J. van der Linden decided it would be possible to construct the factory if weight could be kept to a minimum. The factory section was given a handsome aluminum exterior. As an added attraction, its elegant main entrance doors employ contrasting anodized aluminum — gold and silver. The wing is built with a steel skeleton and faced with removable lightweight aluminum Q-panels.

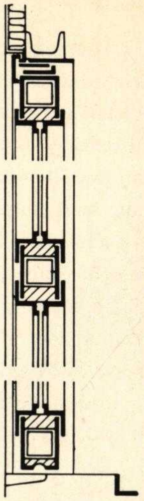
This weight-saving solution also added considerably to the attractiveness, flexibility and all-around efficiency of the completed manufacturing plant.



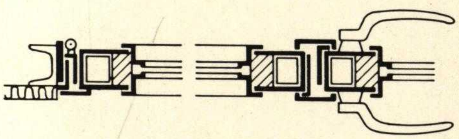
Above In this factory with aluminum wall panels on steel framing, the windows have been grouped for maximum efficiency and appearance. **Above Right** Architectural details of the color anodized aluminum front doors as well as a view of the entrance and doors. **Lower Right** One glistening aluminum side of the factory carries the company name in large, lightweight letters that suit the simplicity of the architecture. The building serves dual functions — administrative and manufacturing — so is divided into two parts, office and factory. These appropriately reflect two architectural styles — Dutch and American. The office section is faced with Dutch brick specially made in peat-fired furnaces. The manufacturing section is in typical United States factory style with aluminum Q-panels. The interior of this sleek-looking factory is filled with clean colors — olive, red, yellow, and turquoise with slate gray, that please the spick-and-span Hollanders.



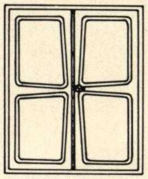
DETAIL ALUMINUM MAINENTRANCE DOOR



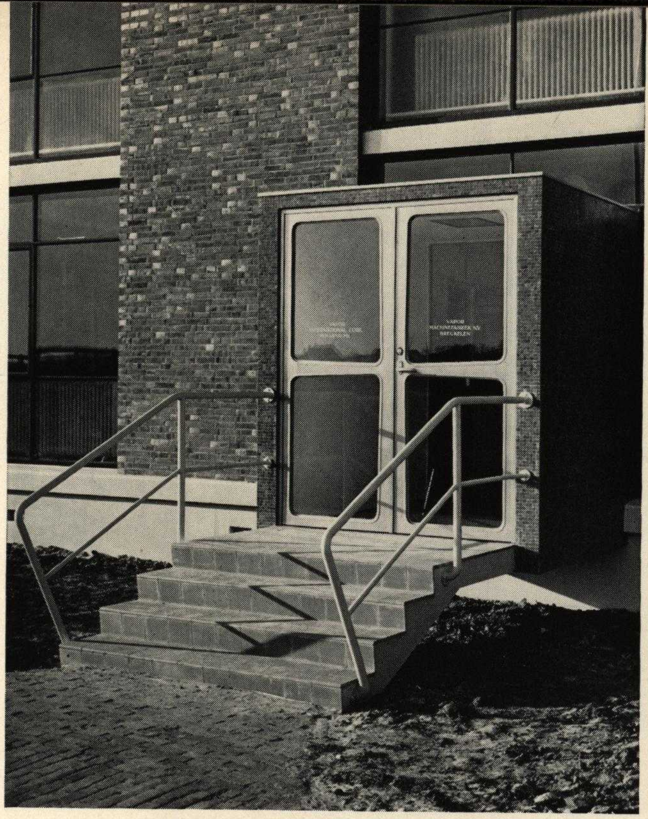
DETAIL VERTICAL SECTION

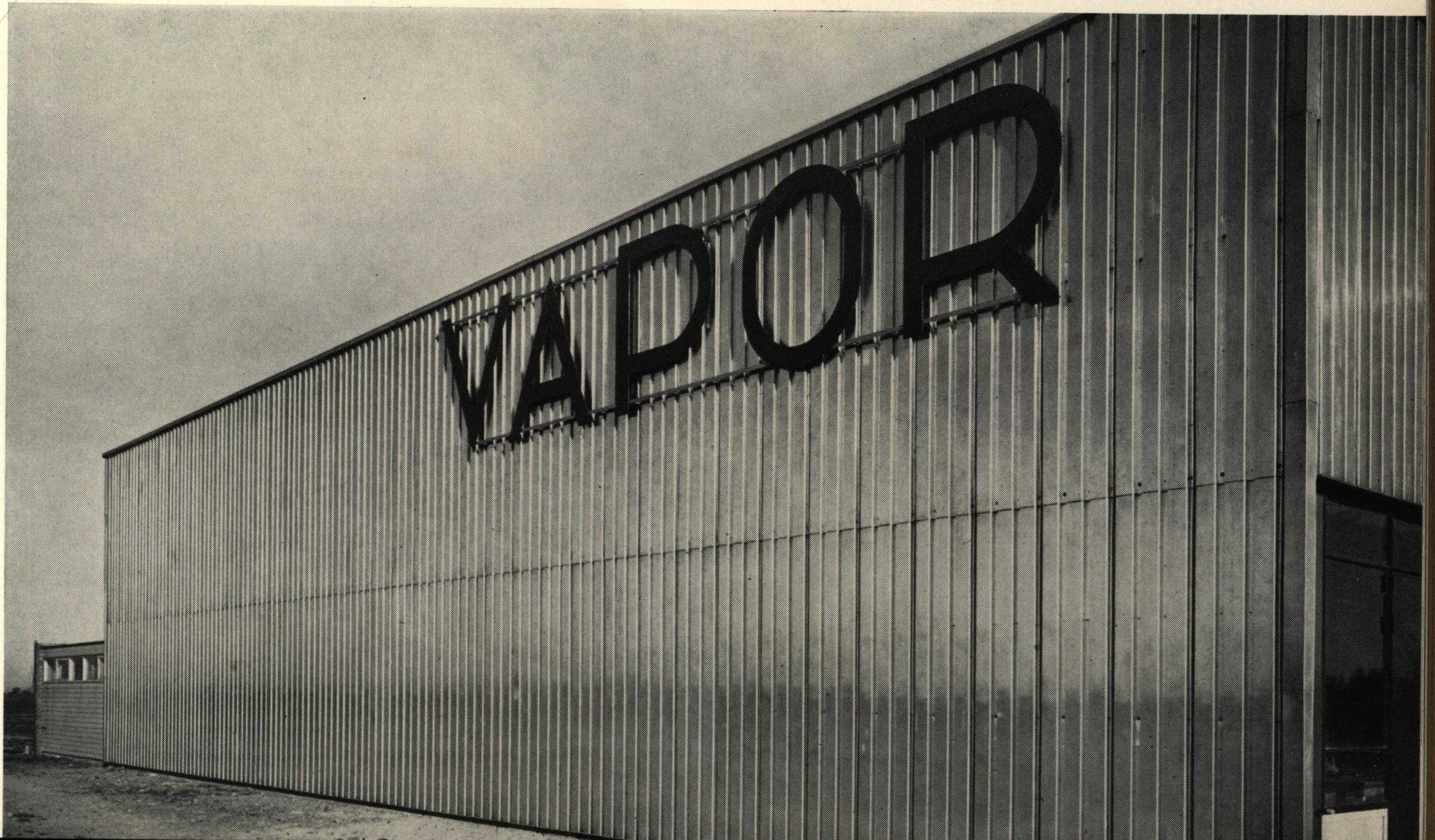


DETAIL LEVEL SECTION



ALUMINUM MAINENTRANCE DOOR

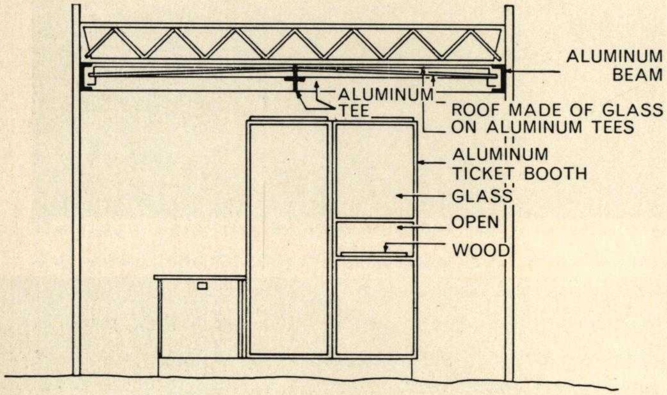




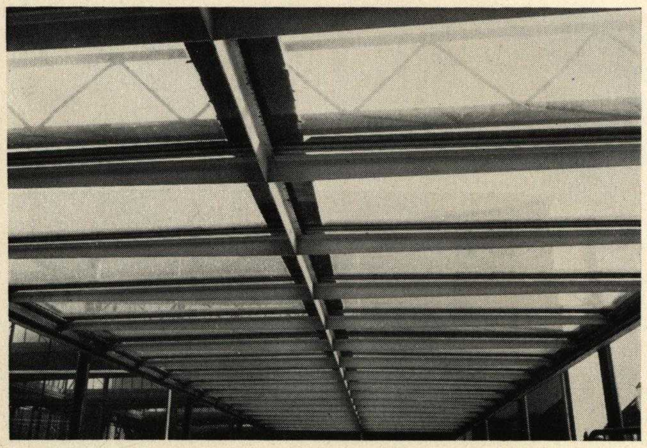
Exhibition Building and Main Entrance Danish National Fair

Fredericia, Denmark, 1954

Acton Bjorn and Axel Olesen



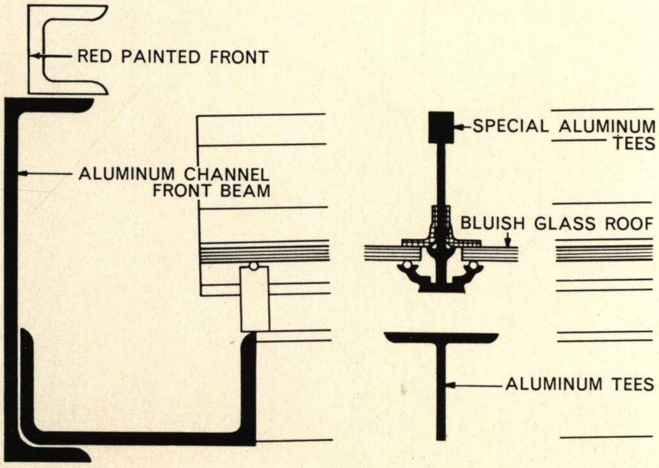
Above These drawings detail the general construction of one of the main entrance ticket booths and indicate the way aluminum was employed. **Below** The close-up view under the main entrance canopy reveals the aluminum-framed blue glass roof.

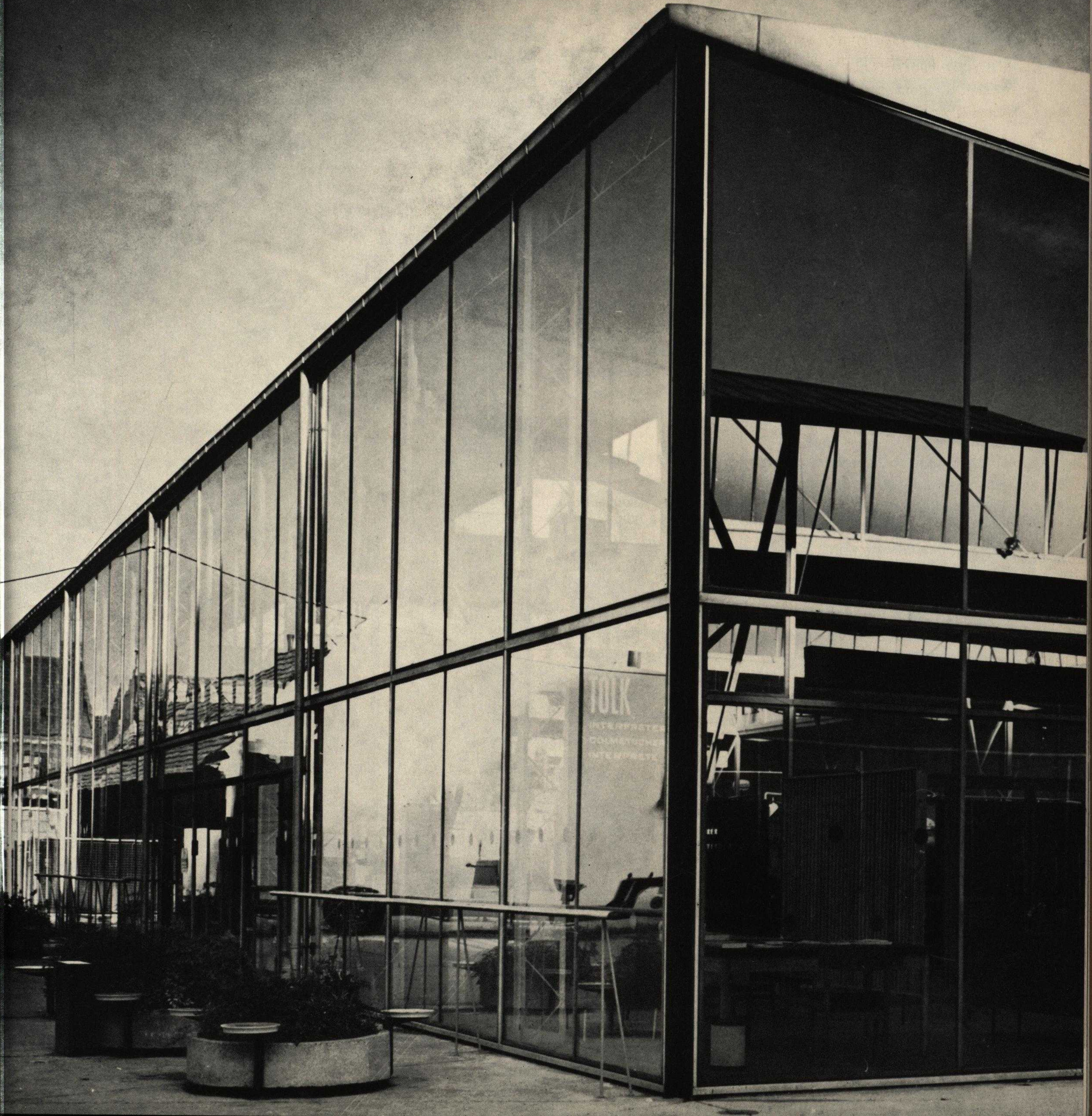


This glistening exhibition building reflects the festive spirit associated with the Danish National Fair and the elegant styling associated with modern Danish craftsmanship. Its simple lines give it striking architectural refinement that is far more attention-getting than flamboyant exhibition cliches. The neutral tones of its glass and aluminum facades have been carefully selected to make it a pleasing background to the brilliant colors of the show.

The exhibition building's roof and solid walls are concrete; its facades are largely aluminum and glass. The Fair's main entrance is a roof of blueish glass and aluminum supported by dark grey steel construction. The entrance features aluminum-framed, glass ticket booths that provide a simple yet stylish introduction to the grounds.

Above The flat edge of the entrance canopy carries the tastefully lettered name of the exhibition. **Right** The sheer elegance of this hall sets a new standard for exhibition architecture. **Below** Detail drawings of the entrance canopy reveal the precision with which aluminum was used throughout.




TOLK
INTERPRETER

Residence

Lake Bluff, Illinois, 1956

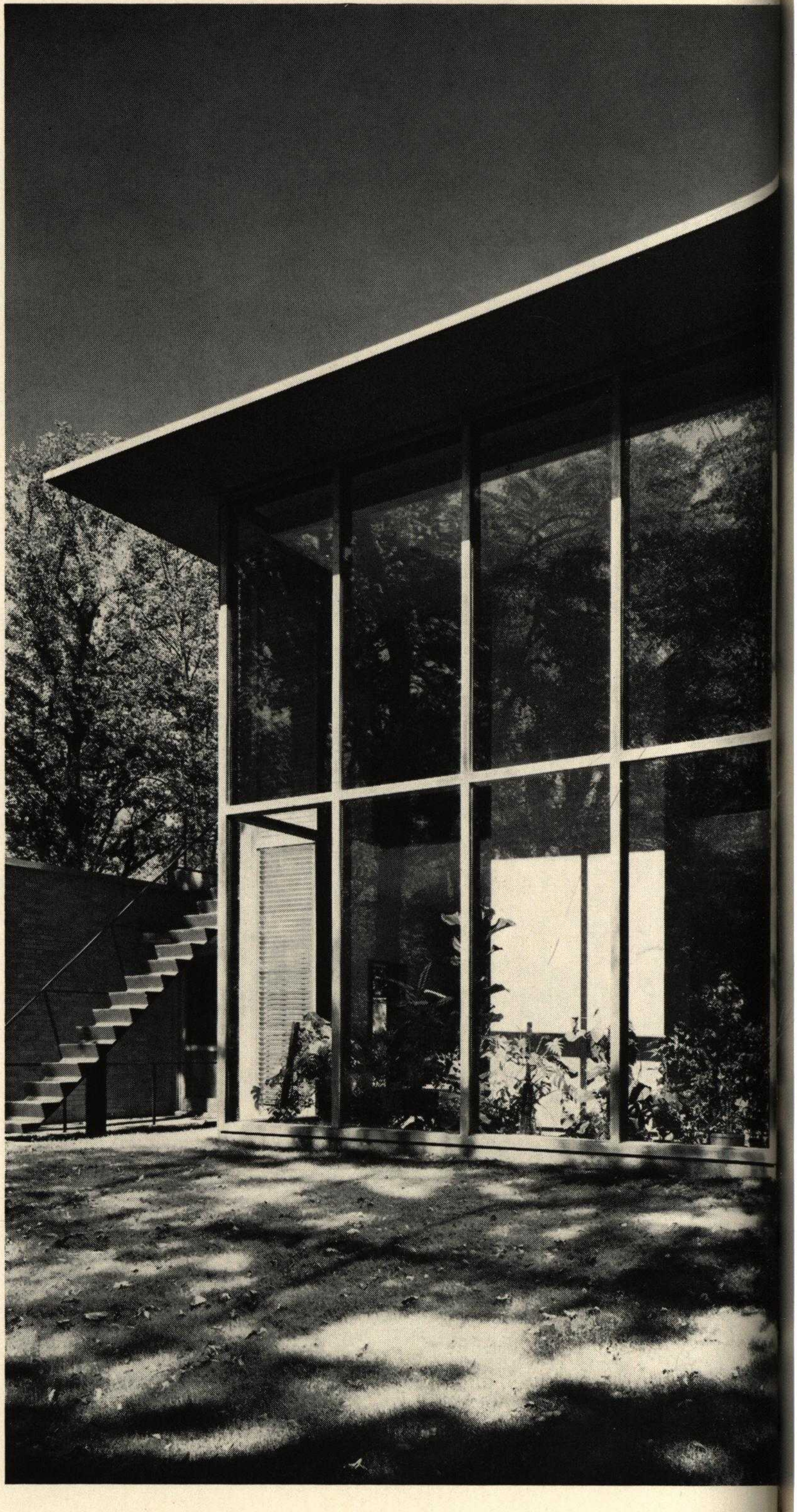
George Fred Keck and William Keck

This beautiful home, located in a suburb of Chicago, is built around a two-story picture window. Majestically situated on a high, wooded plateau, the residence commands a breathtaking view of Lake Michigan.

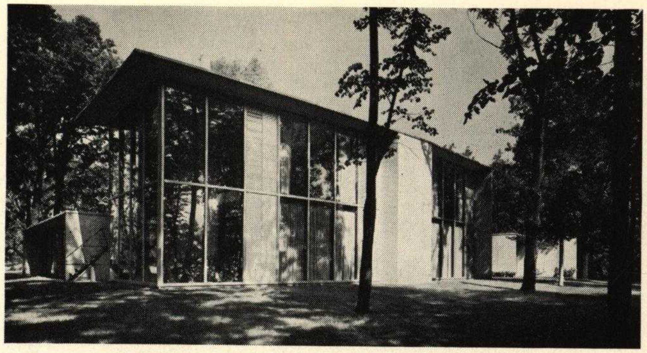
Architects George and William Keck designed this house on a plan appropriately curved to fit the location. The 300-foot radius bends the main rooms in a subtle curve affording them a lake view while protecting them from the glare of the sun from the south.

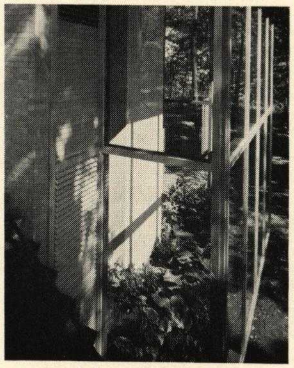
The house, of fireproof construction throughout, is built of masonry, steel, aluminum and glass. The double-glazed glass reflecting the site contrasts with walls of white brick. All exterior trim is aluminum and ventilation is through adjustable aluminum louvers. The louvers, which provide substantial weather control, are of considerable importance in this exposed location — one that is frequently visited by severe storms.

The interior of the residence has been carefully coordinated with the architecture of the exterior and reflects the same design qualities. A feeling of spaciousness is achieved by providing a main entry and two sub-entries which divide the house according to its diverse functions, such as living room, children's wing, garage and service wings. At the south end of the house an elegant two-story solarium opens into the master bedroom. Here is a house with a sense of style and space.

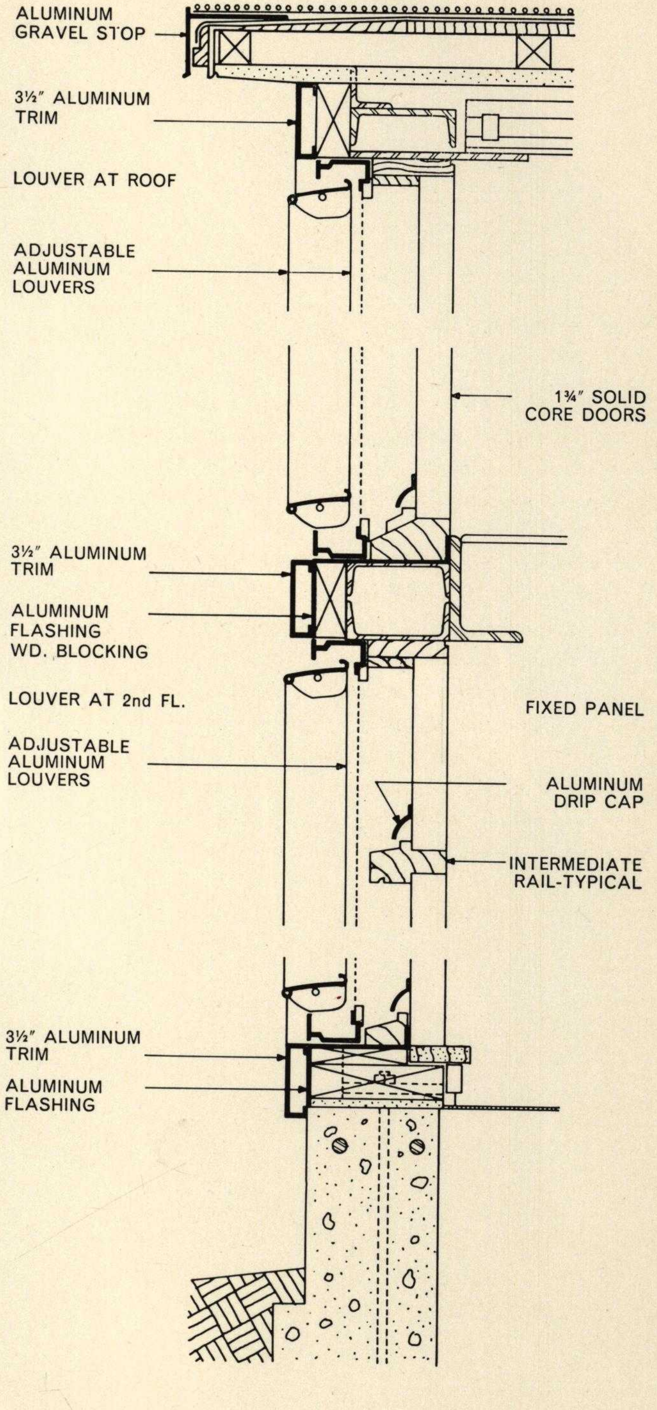


Right This two-story solarium indicates a house of individuality. The precise detailing and workmanship of this aluminum, glass window wall, and the cantilevered stairway, confirms that this is a house of quality as well.





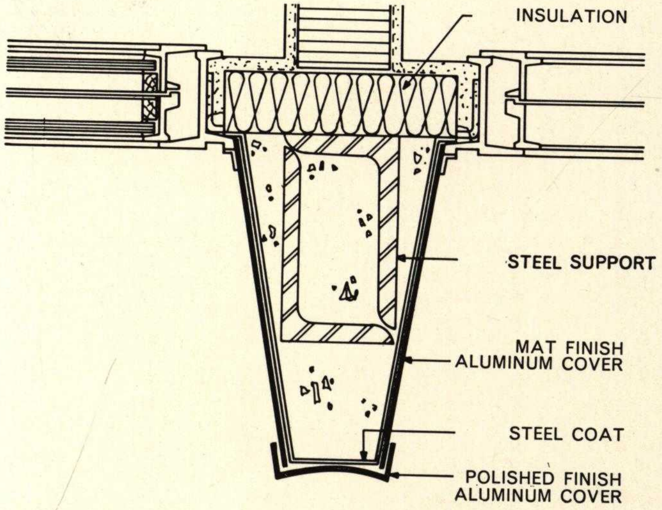
Top The two-story wing which contains living room and master bedroom overlooks a wooded view of the lake. **Above Left** The living room itself looks out across an indoor planting area. **Above Right** The indoor garden is inside double-glazed aluminum windows with adjustable aluminum shutters conveniently operated from inside. **Right** Detail drawing of the two-story window wall. **Below** The long stairway and high aluminum-framed windows give a classic scale to this modern interior.



Burohaus Pempelfort

Dusseldorf, West Germany, 1953

Helmut Hentrich, Hans Heuser

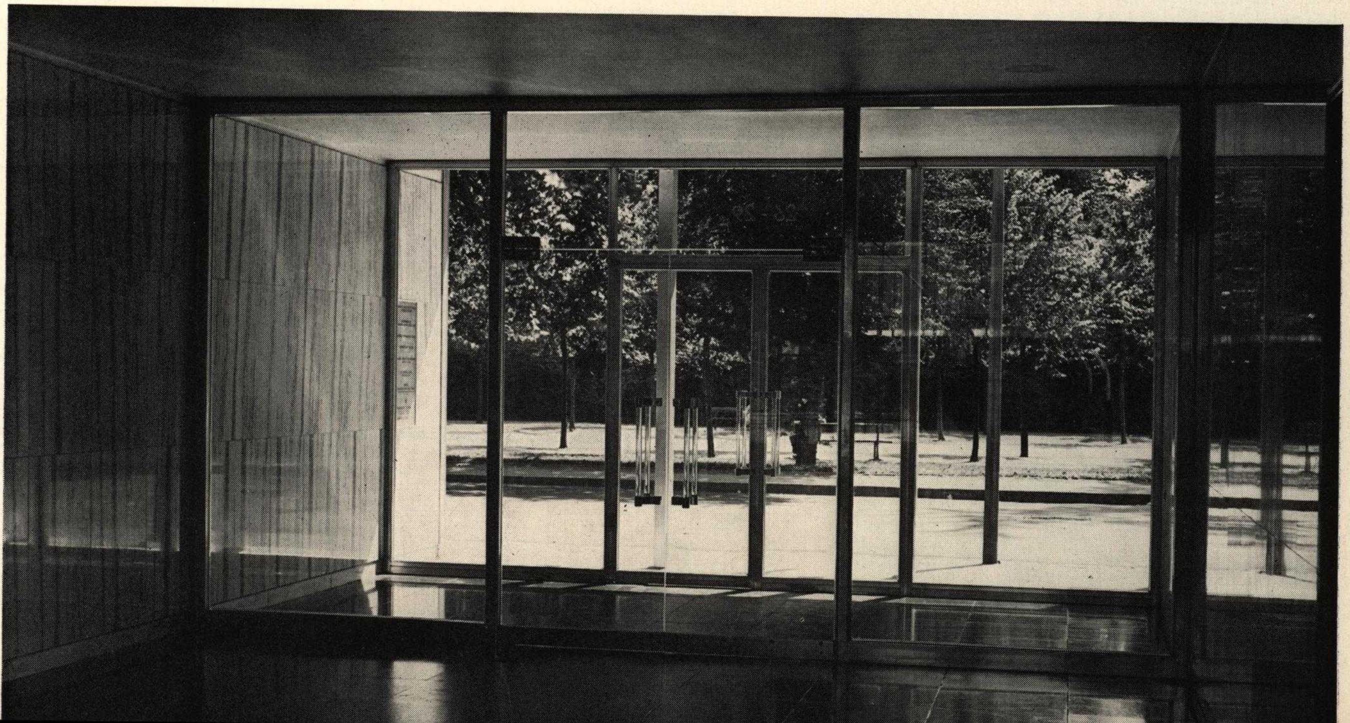


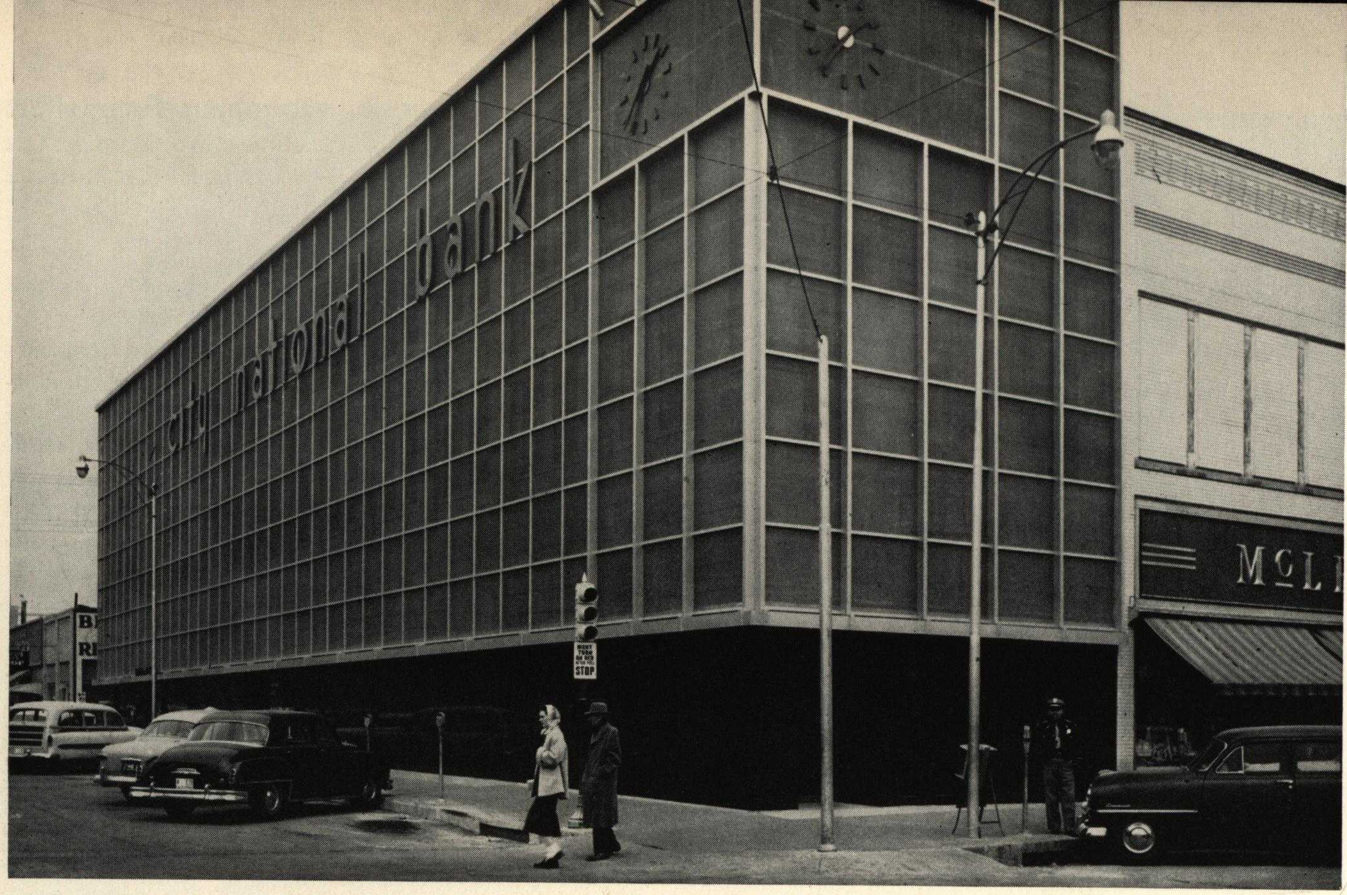
Above Detail drawing shows the steel supports encased in aluminum sheet. The concave front parts are anodized in natural gloss and the side parts in natural dull. **Left** The balconied street facade of the building shows the aluminum railings finished in anodized black and natural. **Below** The front entrance from inside shows the fresh appearance of the glass and black anodized aluminum windows and door frames.

One of the astonishing post-war phenomena has been the rapid recovery of West Germany. One of the outstanding manifestations of this resurgence is its return to architectural importance with buildings such as this office in the industrial city of Dusseldorf. The machinelike precision of both the parts and the planning in this six-story business structure is typical of the new German building style.

The plan of the building is both simple and practical. Each office floor is divided by a long corridor hall down the middle with offices on each side. At the center in the back are elevators and a spiral stairway. Ground floor has two apartments for help. Top floor has two apartments for tenants.

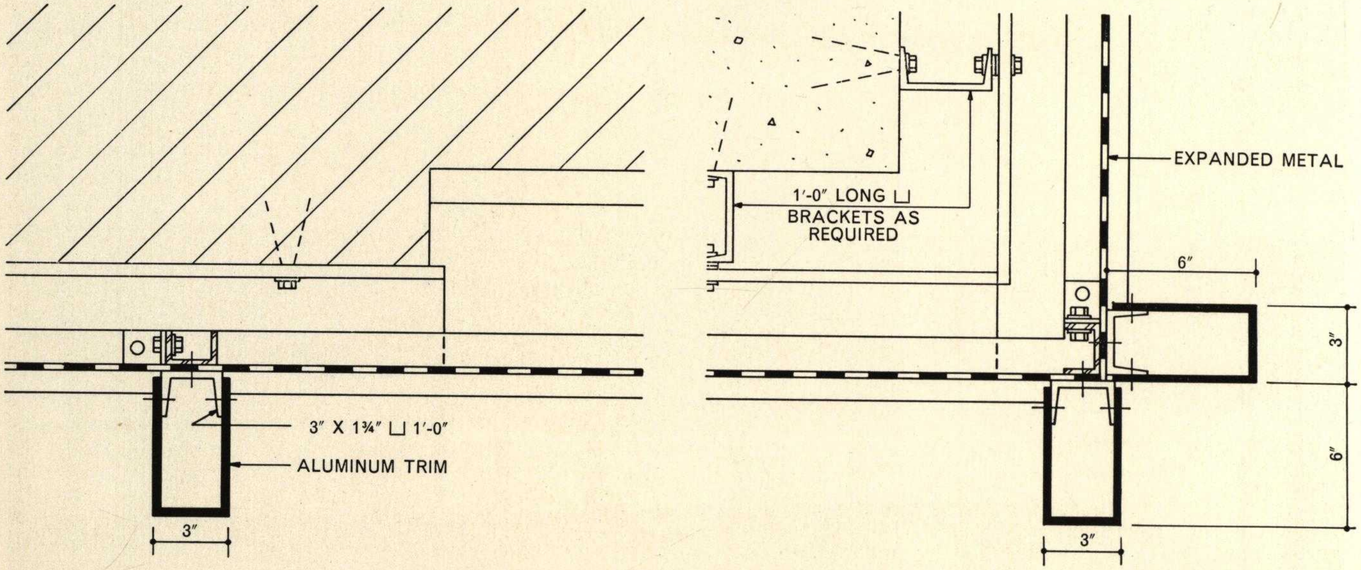
The building is of reinforced concrete and steel construction. The street-side steel supports are encased in aluminum. The black anodized window frames throughout the building give it the remarkable crispness of a draftsman's pen-and-ink detail drawing. Beautifully proportioned aluminum railings on balconies and stairways are the building's most enriching elements. The attractive balconies afford an equally attractive view of the park and gardens just across the street. This is a building clean, precise and beautifully suited to its purpose.





Above The remodeled bank with the completed aluminum facade, new clock and simple granite base suits the prospering City National's modern up-to-date banking methods.

Below Detail drawing of the simple design of the screen wall. Mesh used was ½" by 0.081-inch thick aluminum expanded metal, framed and attached to the existing building with aluminum structural shapes.



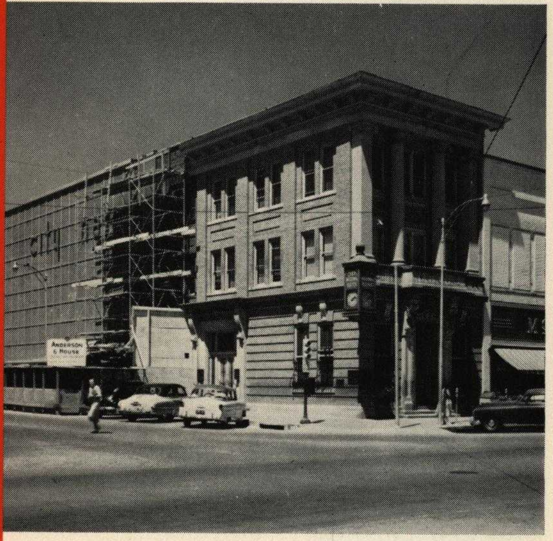
Just a little over a year ago, the books, "Aluminum in Modern Architecture," were published by Reynolds Metals Company. Their widespread acceptance by architects and engineers as the authoritative work on the use of aluminum in building exceeded all our expectations.

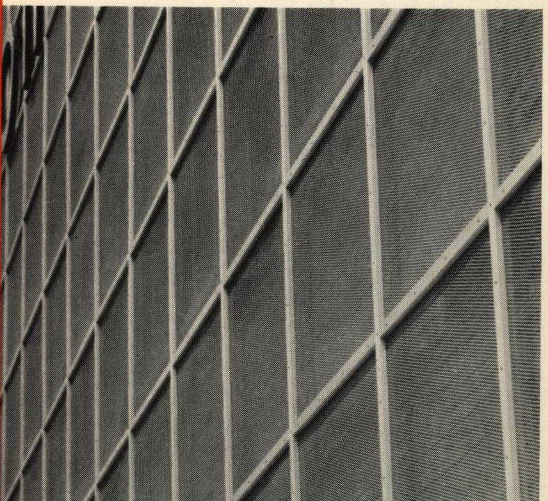
It is a tribute to the venturesome skill and imagination of the architectural profession that the supplement, "Aluminum in Modern Architecture — 1958," is required so very soon. From the first R. S. Reynolds Memorial Award building selected by the American Institute of Architects to the comprehensive index at the back of the book, we hope you find this supplement both interesting and useful. We also hope that you will feel free to call the Reynolds Architectural Representative in your area for any additional information or help.

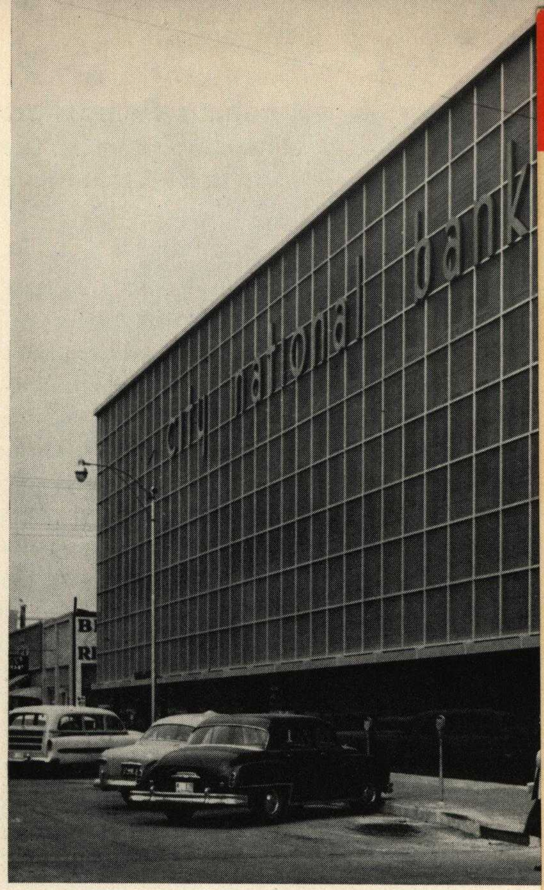
R. S. Reynolds, Jr.
President,
Reynolds Metals Company

City National Bank

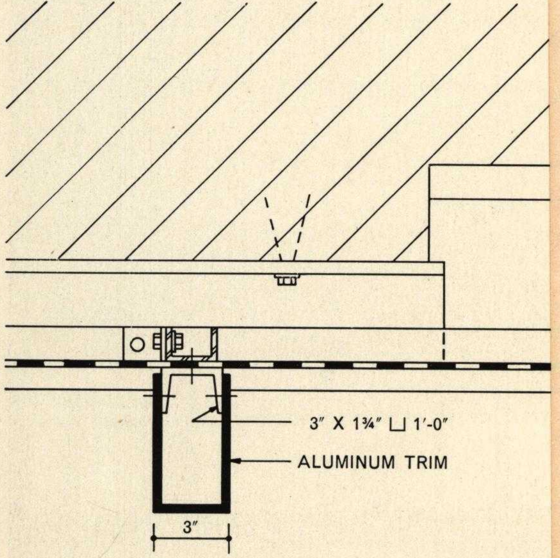
Lawton, Oklahoma
Paul Harris, 1956







Above The remodeled bank with the completed aluminum facade and simple granite base suits the prospering City National's mo date banking methods.



City National Bank

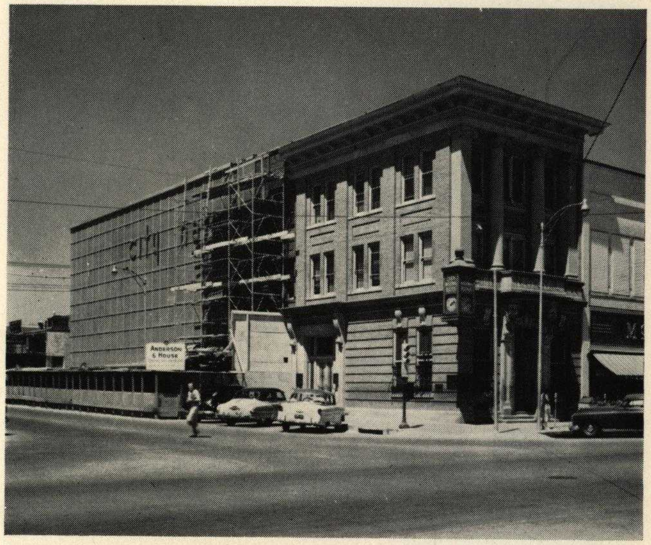
Lawton, Oklahoma

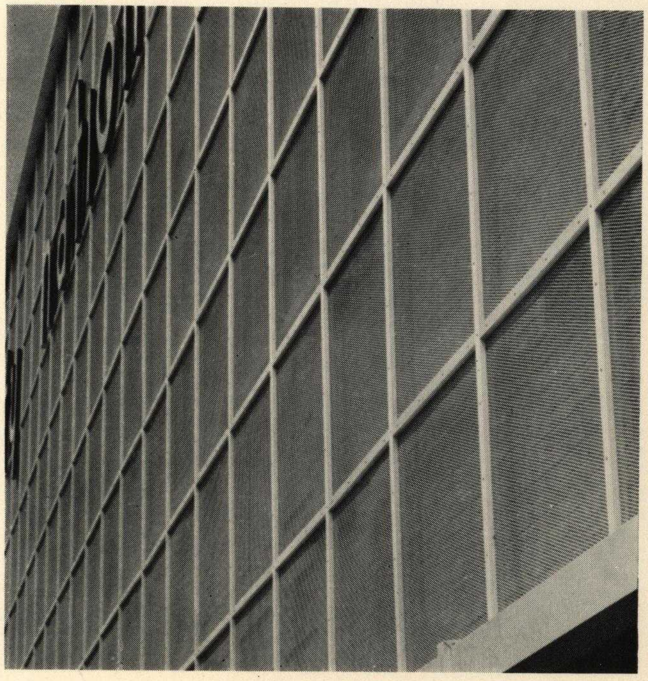
Paul Harris, 1956

Remodeling is the stepchild of modern architecture. The Cinderella look of this Oklahoma bank is due to the smart remodeling of Midwest architect Paul Harris. He covered this bank, built back in 1909 on an Indian Reservation, with a modern anodized aluminum overcoat.

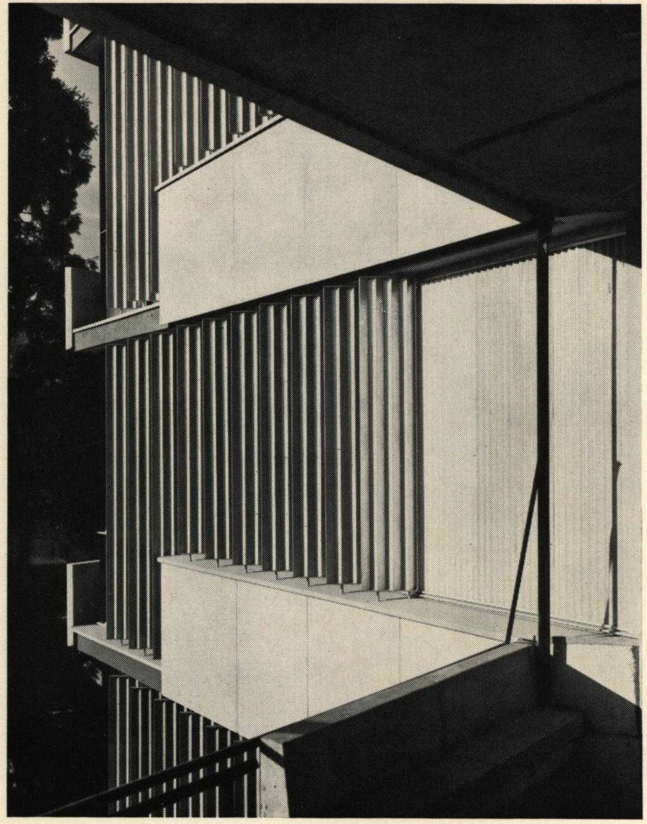
Expanded aluminum was selected for the bank's new windowless facade because of its light weight, its transparency and its sunshading effect. The shading was an important extra benefit, especially on the long west wall that is exposed to Oklahoma's blistering summer sun. Cost of the project was greatly reduced by the fact that the modernization required no alteration of the original facade. This also allowed office business to proceed without the expensive interruptions normally associated with remodeling. Light and air freely enter the aluminum mesh which screens the original windows. Harris was able to design a facade without breaking the simple grid pattern with complicated window openings. Rustproof aluminum, used also for framing members and trim, contributed to the facade's low maintenance and speedy erection.

The Lawton bank is a straightforward example of how aluminum cladding is being used today for low cost modernization of buildings that have an outdated appearance but a structure that is still sound.





Above The original exterior of the City National Bank of Lawton can be seen with the remodeling in progress. Scaffolding to erect the lightweight panels was kept at a minimum by moving it progressively along the wall.
Below Close-up reveals how the open grid screens the old exterior of the building without closing window openings.



Miremont-Le-Cret Apartment

Geneva, Switzerland, 1957

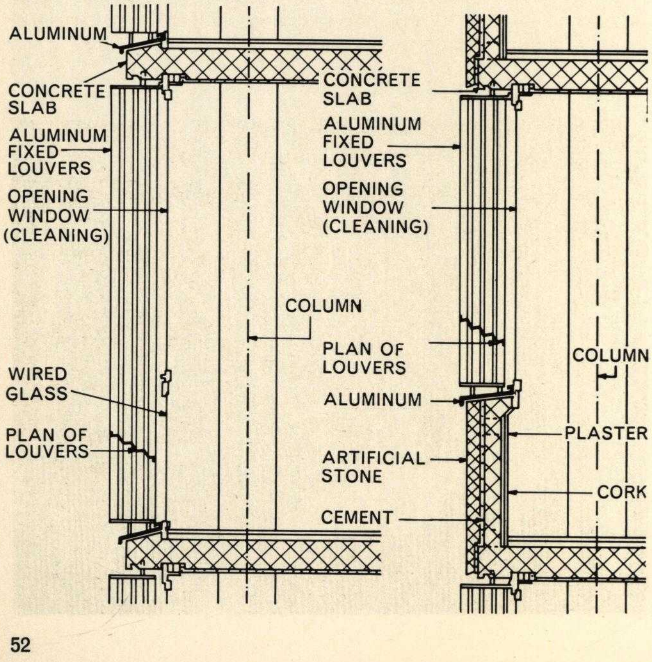
Marc Saugey

Architect Marc Saugey set out to design a seven-story residence building with all the advantages of both a private villa and a city apartment. His remarkably successful solution was a zig-zag plan and ingenious louvering.

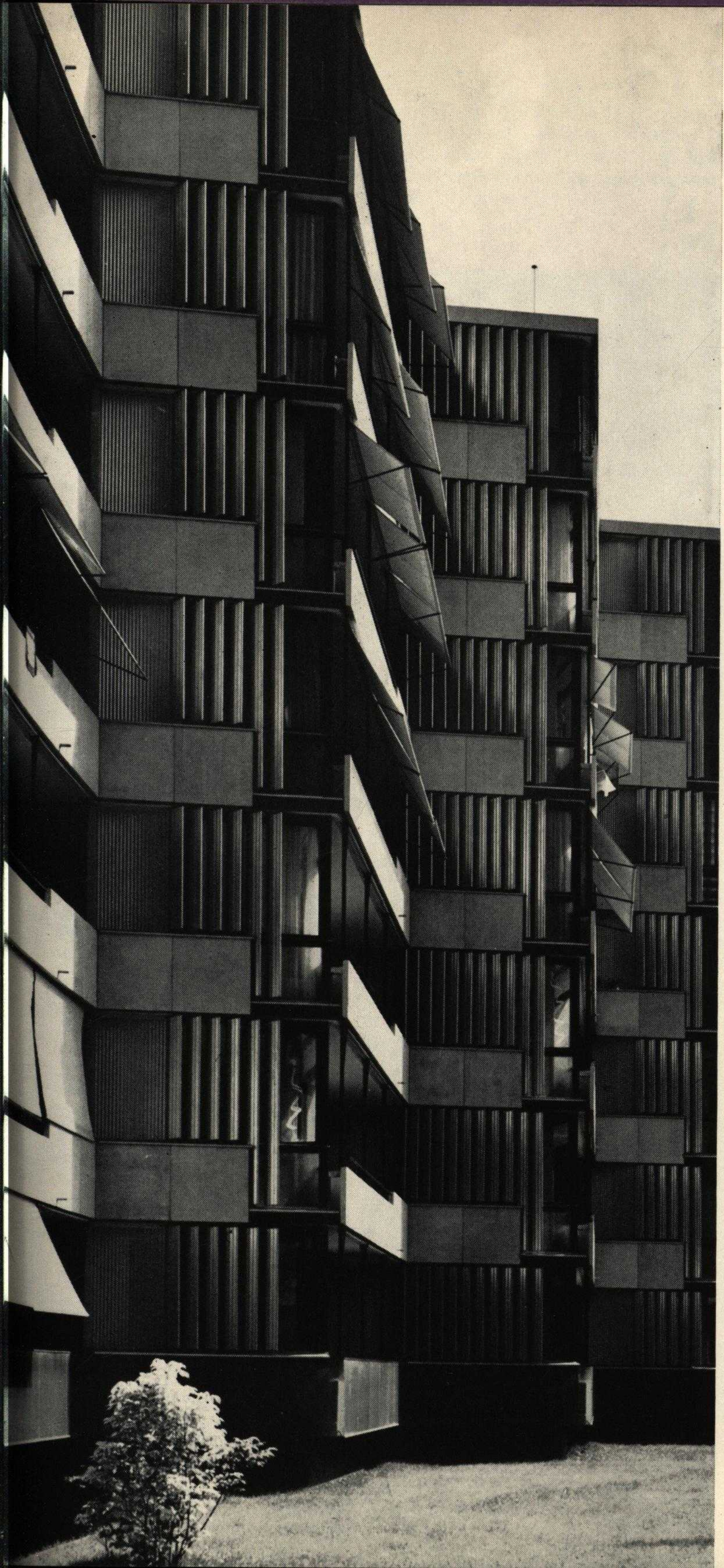
This inventive plan enabled him to provide each apartment with an uninterrupted view and full sunlight. The long, wide balconies give the apartments a striking spaciousness and, like a country terrace, serve as an extra living room in the summer.

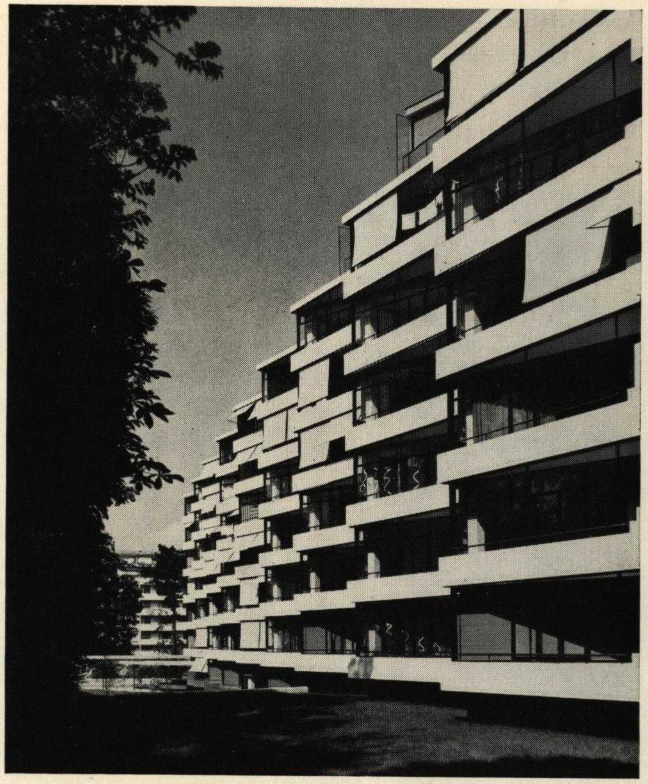
The louvers assure each apartment of complete privacy. After numerous studies, a system of deep, fixed, anodized aluminum louvers was selected. Sheet aluminum was used to fabricate over twelve hundred louvers. These folded sections, held rigid in an aluminum frame, are fixed in position with special fastenings. At the top they are attached with an aluminum dowel grouted into the concrete and at the bottom with a threaded tube to the aluminum sill. Folded aluminum of the same type is used on the facades. Here they were backed with insulation before fastening. The sawtooth plan and louvers give the building an unusual play of light and shade.

"The effect produced," says Saugey, "by this use of aluminum was one of striking lightness and delicacy."

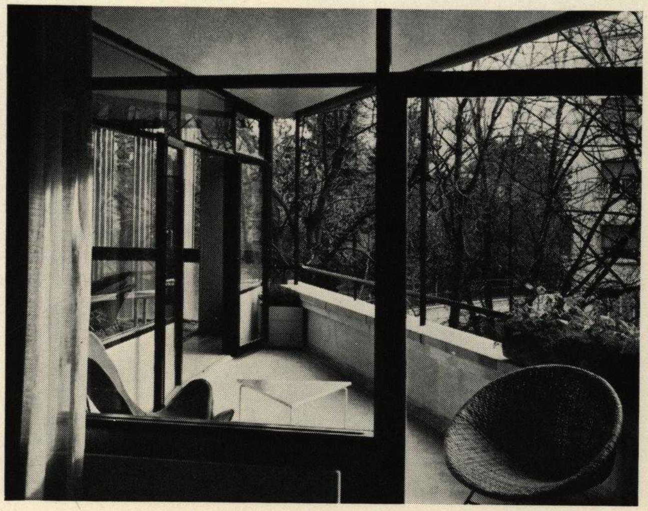


Left Top View from one balcony to a neighbor's shows the complete privacy obtained with the louvers. **Left** Detail drawing of walls indicates the handling of materials. Anodized aluminum is 1/6-inch, folded and framed for stiffness.





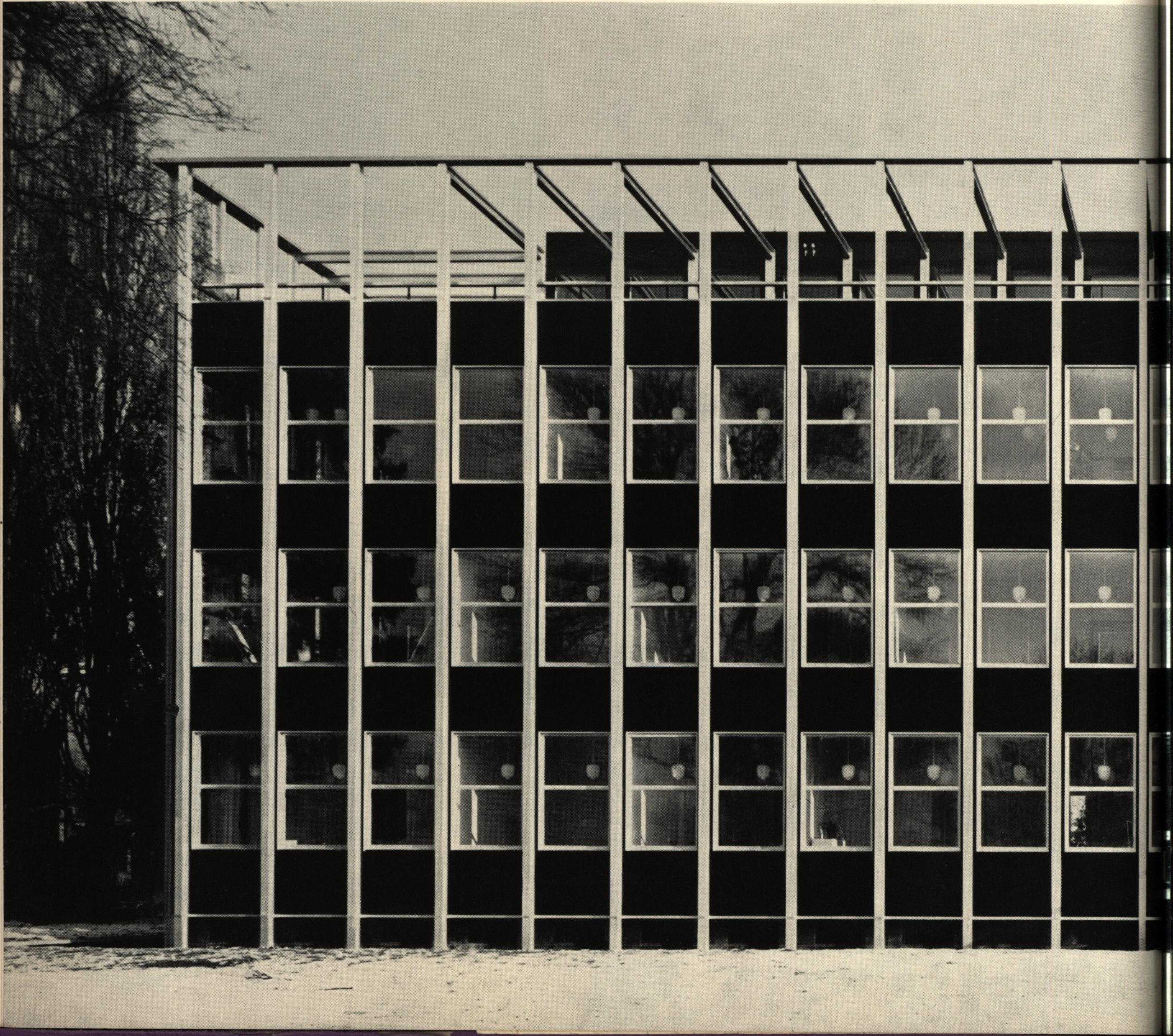
Above This unusually interesting facade was created by Saugey's imaginative and ingenious plan. **Left** The apartment balconies with louvers and awnings provide complete built-in protection from the bright summer sun. **Below** A portion of a typical balcony reveals the wide but sheltered aluminum framed windows and the wooded view.



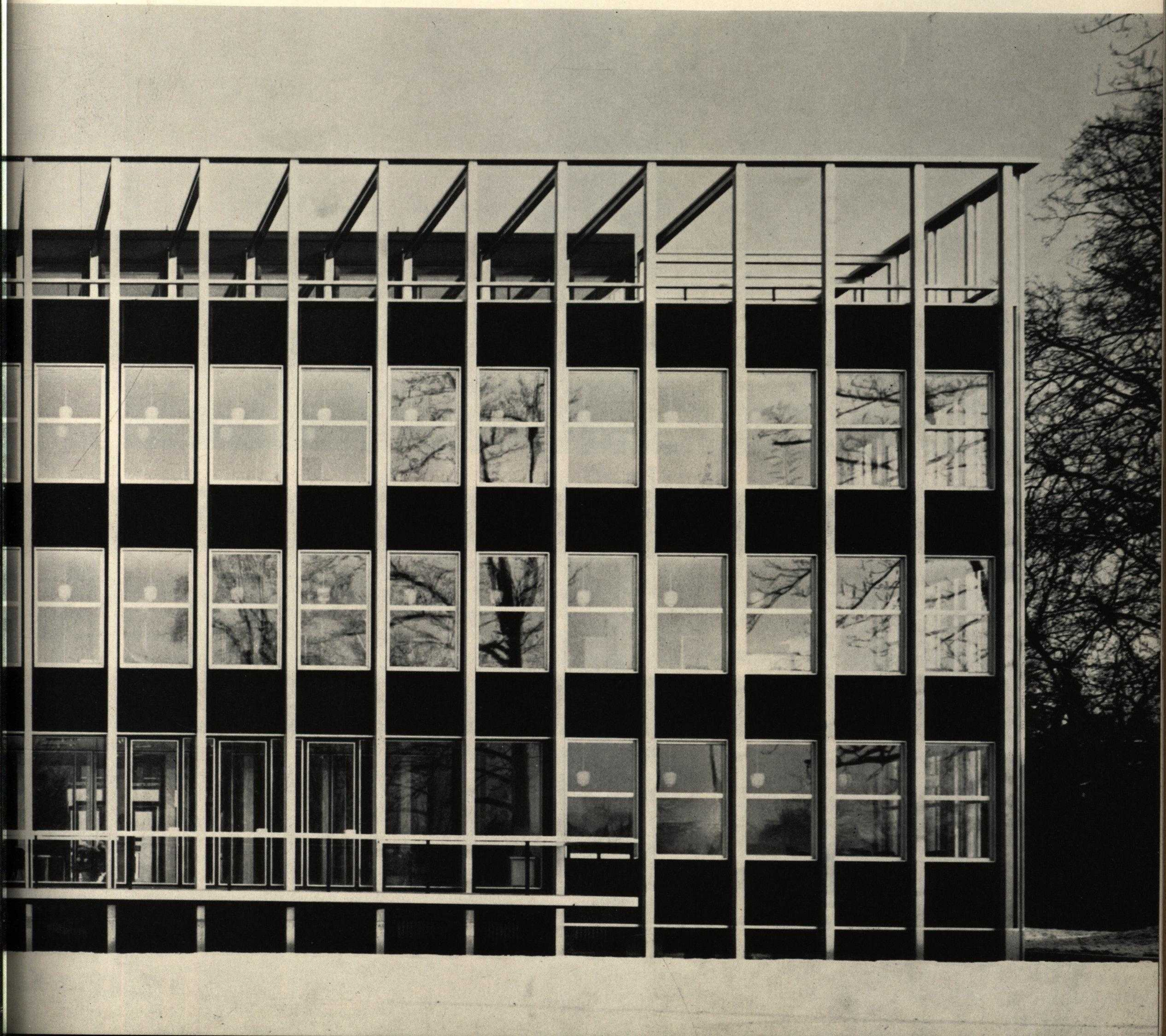
Aluminum Industry Administration Building

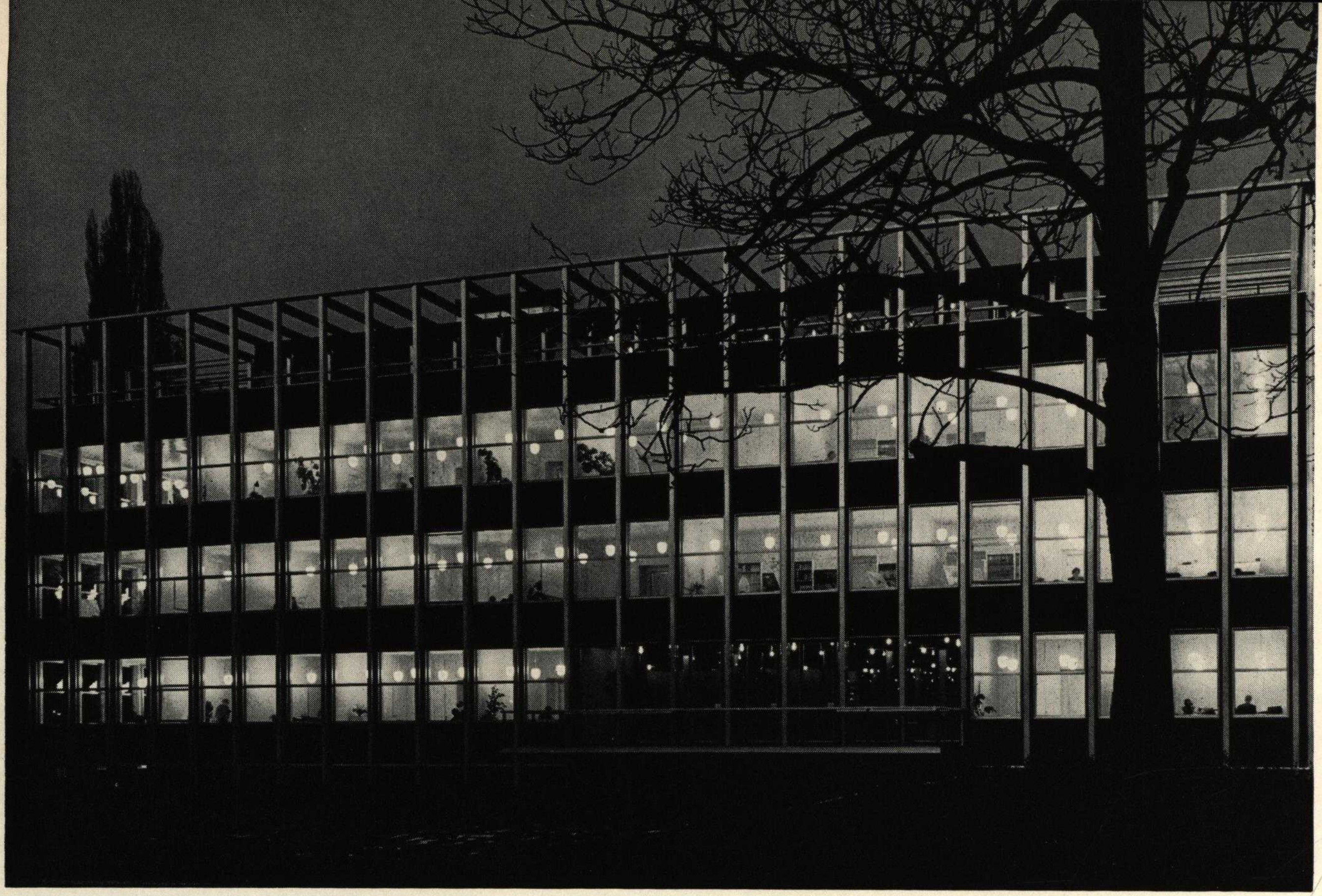
Zurich, Switzerland, 1956

Hans Hofmann



Below Here, viewed from the lakeside, is a Zurich building precise and elegant as a Swiss watch. This administrative headquarters, designed for the aluminum industry by the talented Hans Hofmann, not only has some unusual applications of aluminum but makes the most persuasive argument for its further use — a good and beautiful building.





Above Night view taken from the lake dramatizes the structural qualities of the design; steel framework clad with profiled aluminum members, aluminum framed windows and spandrel panels of anodized aluminum.

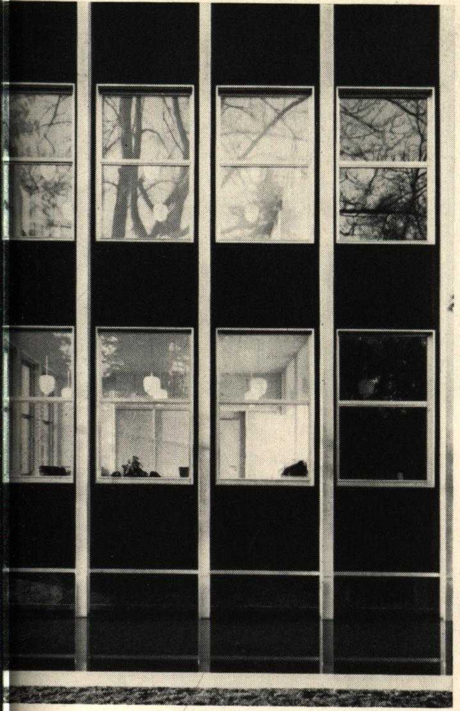
Right This roof terrace with pergola, an ingenious development of the structural framework, provides a sweeping view of Lake Geneva. The roof of the building is a special sheet aluminum construction.

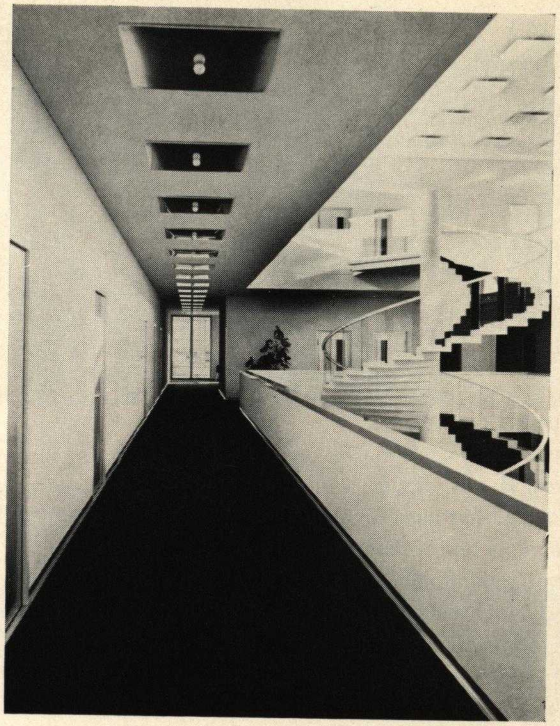
This aluminum-sheathed building is a superb example of Europe's new modern look. It is, as it was intended to be, a stunning showcase for aluminum in architecture.

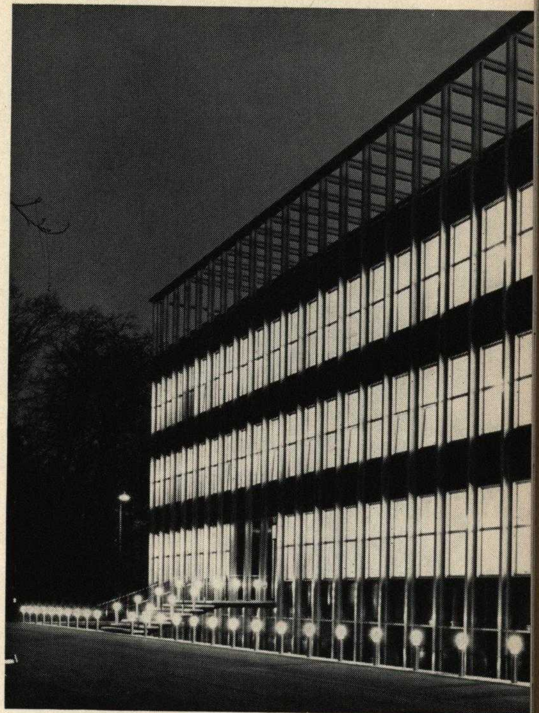
The four-story building has a steel skeleton fireproofed with asbestos and clad with profiled aluminum in natural color. Vertical aluminum double-hung windows have rolldown shutters constructed of aluminum louvers. The dark brown spandrel panels are of anodized-oxidized aluminum. The roof is covered with sheet aluminum. The ceilings are perforated aluminum, backed with insulation material for improved acoustics.

Glass entrance and sliding doors have extruded aluminum framing. The flush office doors are faced with smooth sheet aluminum. Special Swedish lighting fixtures employ aluminum with a highly reflective surface. The architect was given a free hand to design everything down to the smallest detail. For example, the office furniture was specially designed of anodized sheet and extruded aluminum.

The first metal-sheathed structure in Zurich, a city dominated by stone and granite buildings, is also the first new construction in Zurich's lake-front district, which is rapidly being developed by city planners as a green belt reserved for pedestrians. This industrial building introduces a bright, cheerful, modern element into the changing lake-front district — attesting to the bright future of Zurich's progressive city planning program.



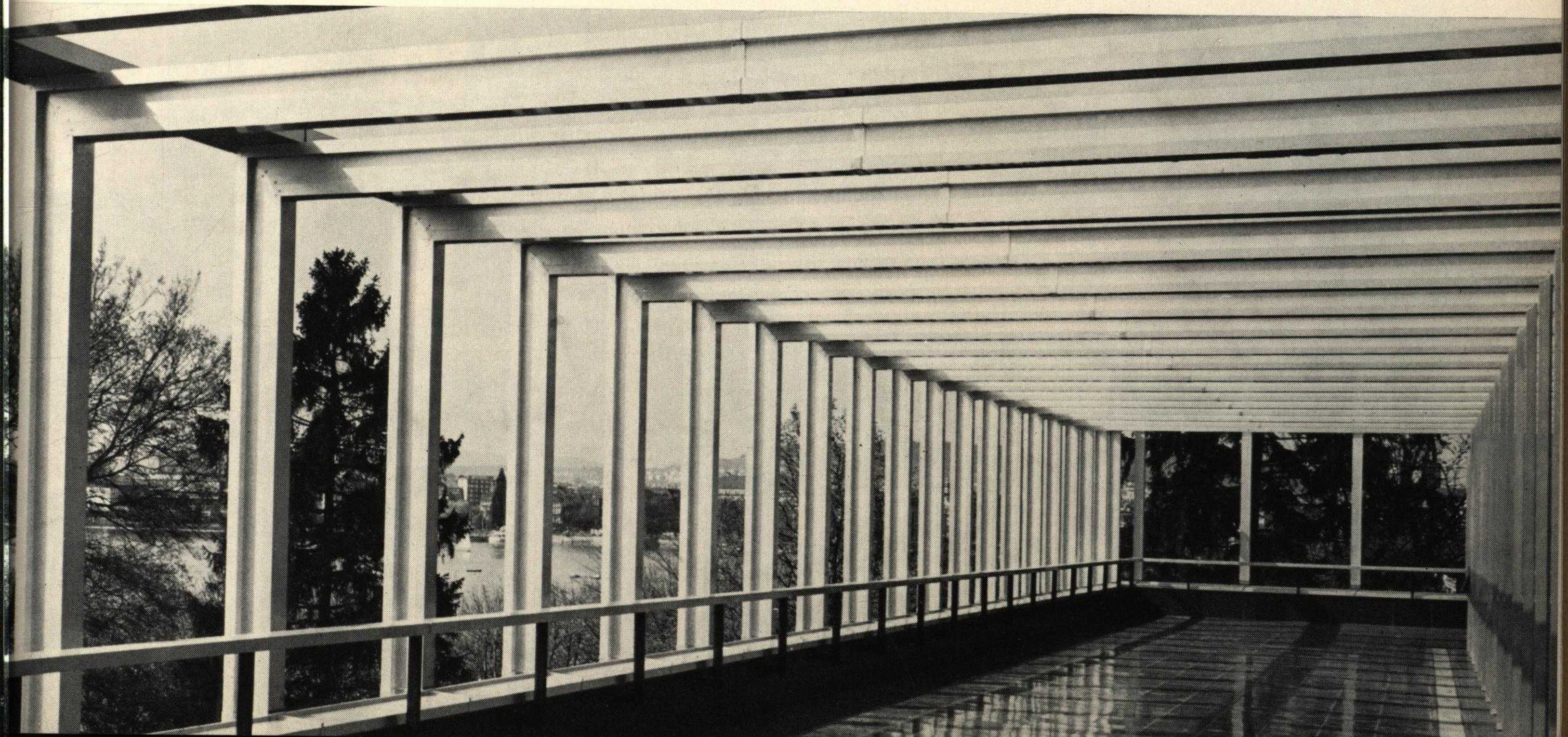




bove This close-up photograph shows the meticulous etailing of the facade as well as the reflecting pool.

Above The elegant stairway which dominates the interior enabled the architect to create a hall ringed by galleries on all floors.

Above Night view of the east side shows reflecting pool and entrance with cantilevered marble steps.



National Museum

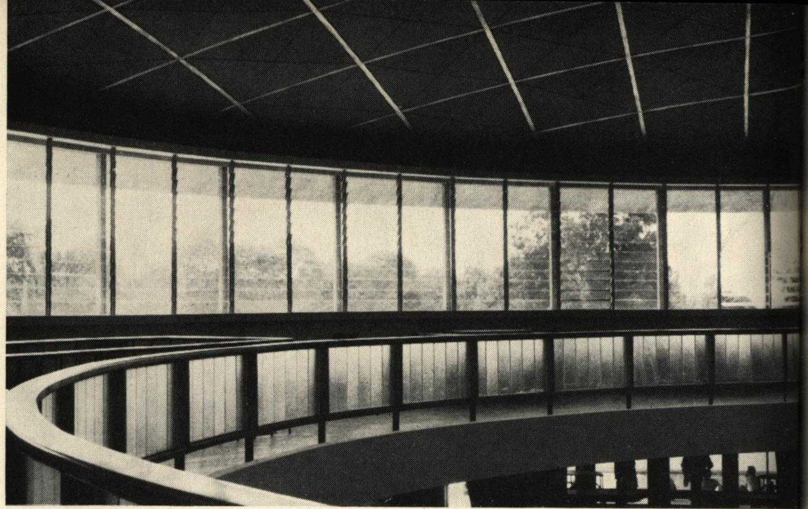
Accra, Ghana, 1957

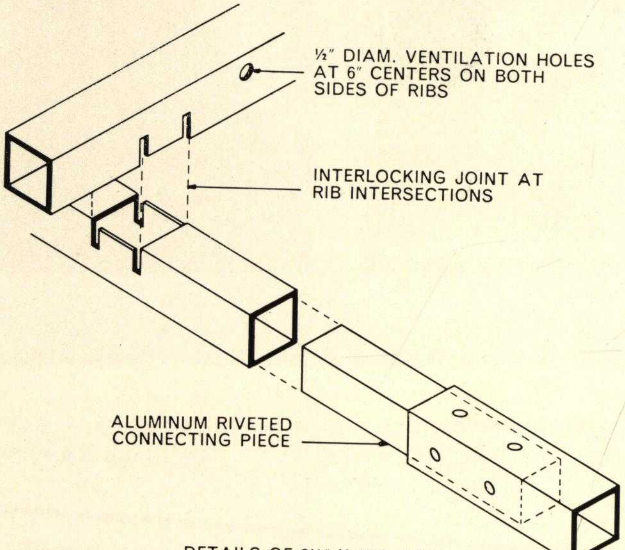
Lindsay Drake and Dinys Lasdun

As early as 1843 when a prefabricated iron palace was transplanted from London to Calabau, Nigeria, to house King Eyambo and his three hundred and twenty wives, Great Britain was a pioneer in the exporting of prefabricated buildings. The aluminum-domed National Museum at Accra, in Africa, is one of the most recent British experiments in architectural prefabrication. Drake and Lasdun, of the important British architectural firm of Fry, Drew, Drake and Lasdun, designed this building for export to the Public Works Department of the Gold Coast Government.

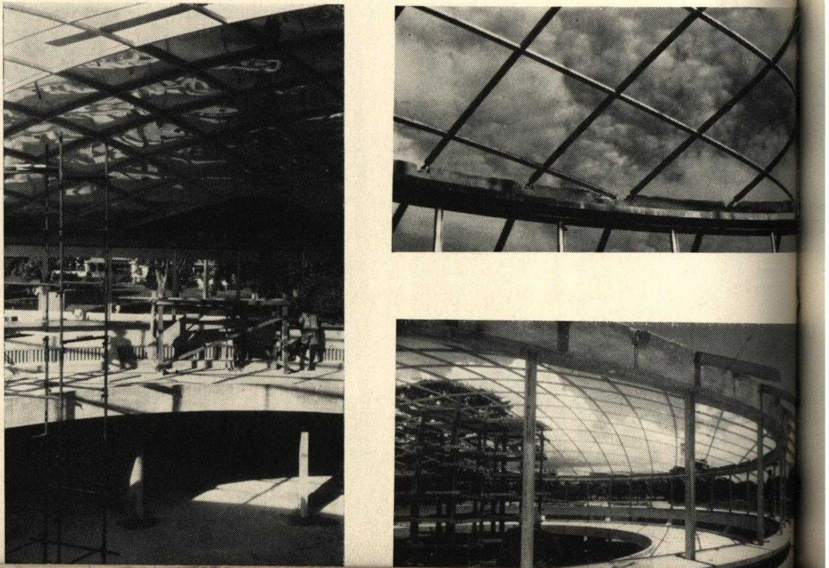
To meet the requirements of a museum, the building specifications called for a large open floor area, a well-illuminated series of wall displays, an upper area for film showings and small scale exhibits, as well as for storage, files and offices. Because of its high resistance to corrosion and its exceptionally low density, aluminum, which is both reflective and waterproof, provided the solution to the architectural problems posed by the construction of a dome in the humid climate of the tropics. Erected on its tropical site in four weeks' time, the dome is constructed of a framework of extruded box-section curved aluminum ribs which are exposed internally and covered externally by aluminum roof sheeting.

Economical, spacious, practical and elegant, the National Museum is a fitting modern tribute to the independence of the new Republic of Ghana.

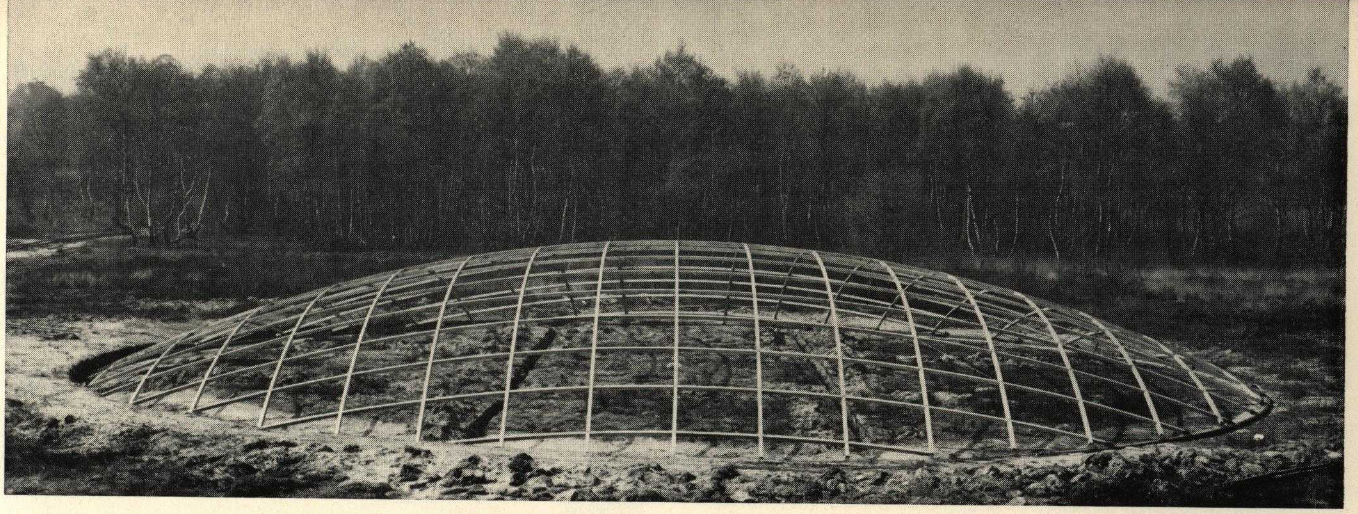



½" DIAM. VENTILATION HOLES AT 6" CENTERS ON BOTH SIDES OF RIBS
INTERLOCKING JOINT AT RIB INTERSECTIONS
ALUMINUM RIVETED CONNECTING PIECE

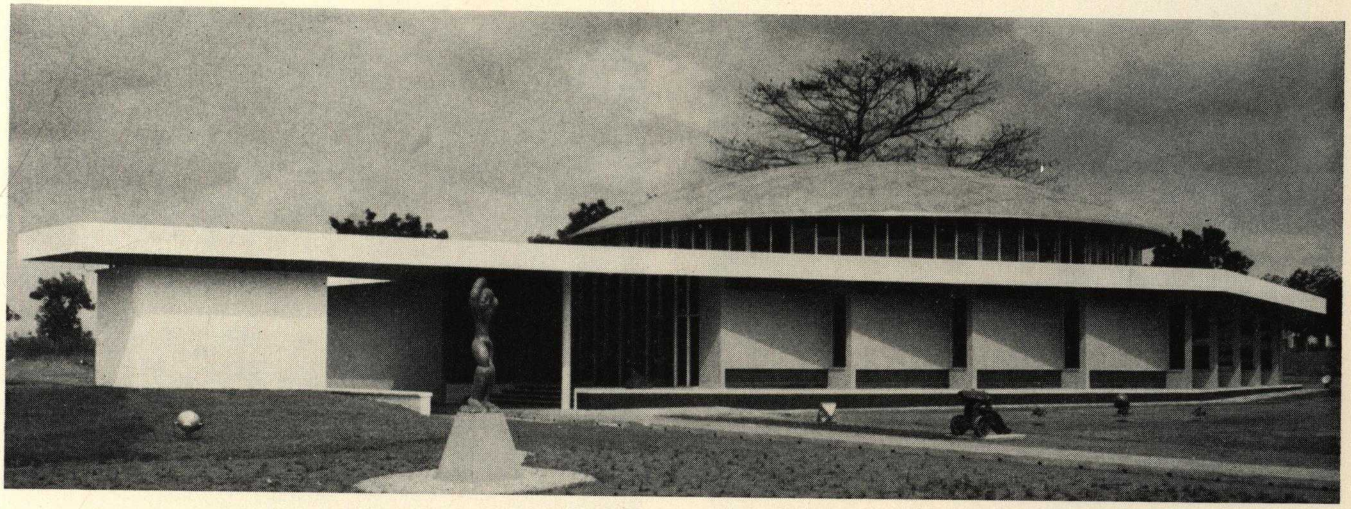
DETAILS OF 2½" X 2½" X 3/16" ALUMINUM RIB CONNECTIONS



Top This photograph of the first-floor gallery reveals the exposed aluminum ribs of the dome and the aluminum jalousied windows. The extremely light roof, two pounds per square foot, required only slim H-section aluminum columns for support. **Middle** Details of roof and rib construction. **Bottom** Three photographs showing the ribs being erected. This framework consisted of 2½" x 2½" x 3/16" extruded box-section aluminum ribs in compression at right angles to each other. They are covered externally with 168 aluminum sheets to form a dome 80 feet across, of stressed-skin aluminum supported on a reinforced concrete ringbeam. The ringbeam takes up the tension and uplift due to wind. The concrete also retains the structure in its spherical shape. Expansion and contraction is taken up by the dome rising and falling. The aluminum ribs have seatings to allow for any slight movement.

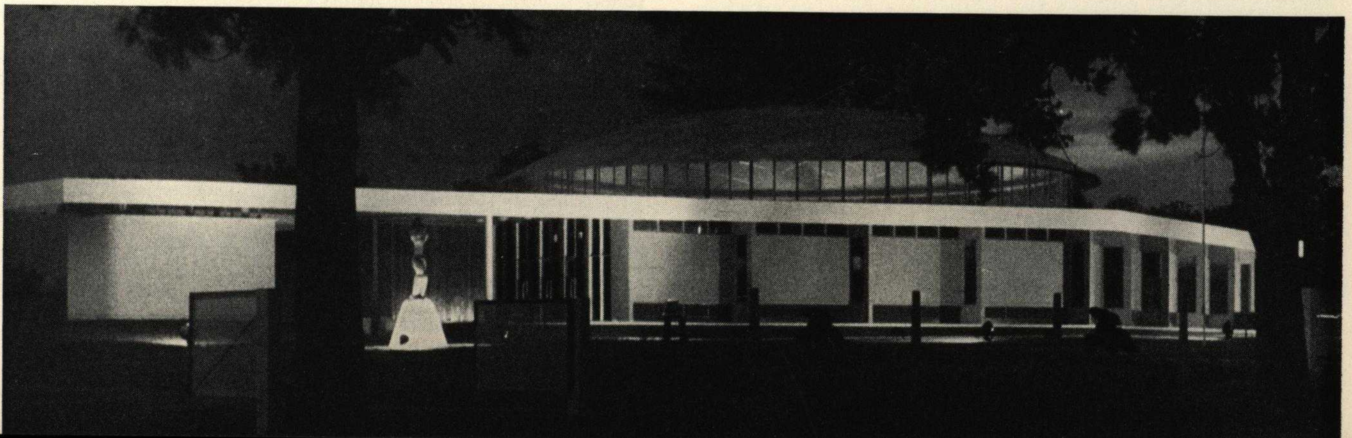


Above The aluminum structure was erected first for checking in England, carefully keyed, then dismantled and shipped to Accra. The aluminum ribs and columns were sent in one 20′x3′x3½′ crate and the aluminum sheeting in two 11′x5½′x1′ crates. Total weight was less than five tons. The success of the building demonstrates that lightweight precision structures can be shipped economically from industrial to less technically developed areas.



Above The main entrance to the completed museum building.

Below The same view in the evening with the building dramatically floodlit.



Administration Building of Mutuelle Vaudoise Accidents

Lausanne, Switzerland, 1955

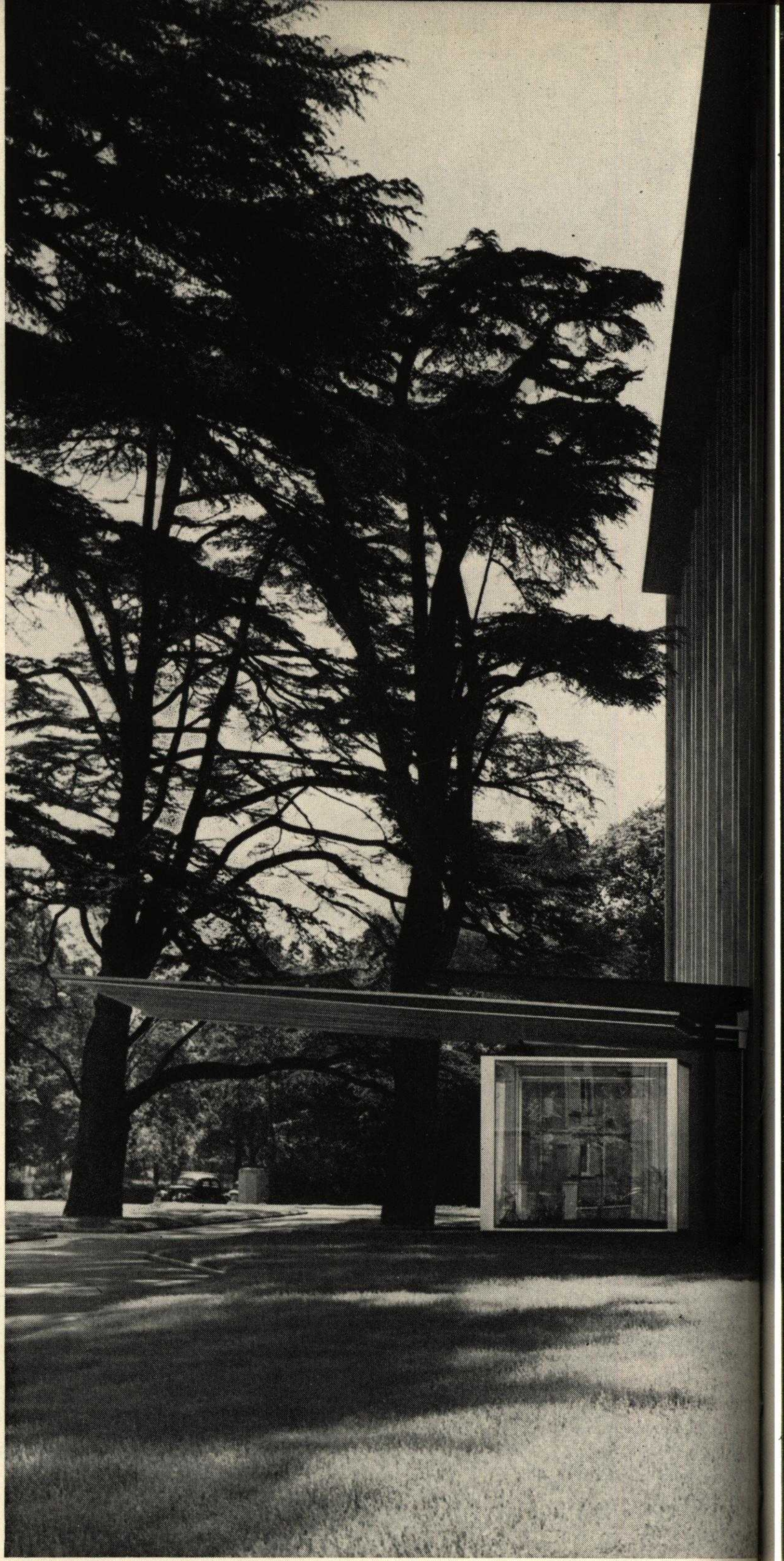
Jean Tschumi

This handsome office building in Lausanne, Switzerland, is designed around a view. It is an open quadrangel with three wings looking out upon the lovely landscaped shores of Lake Leman.

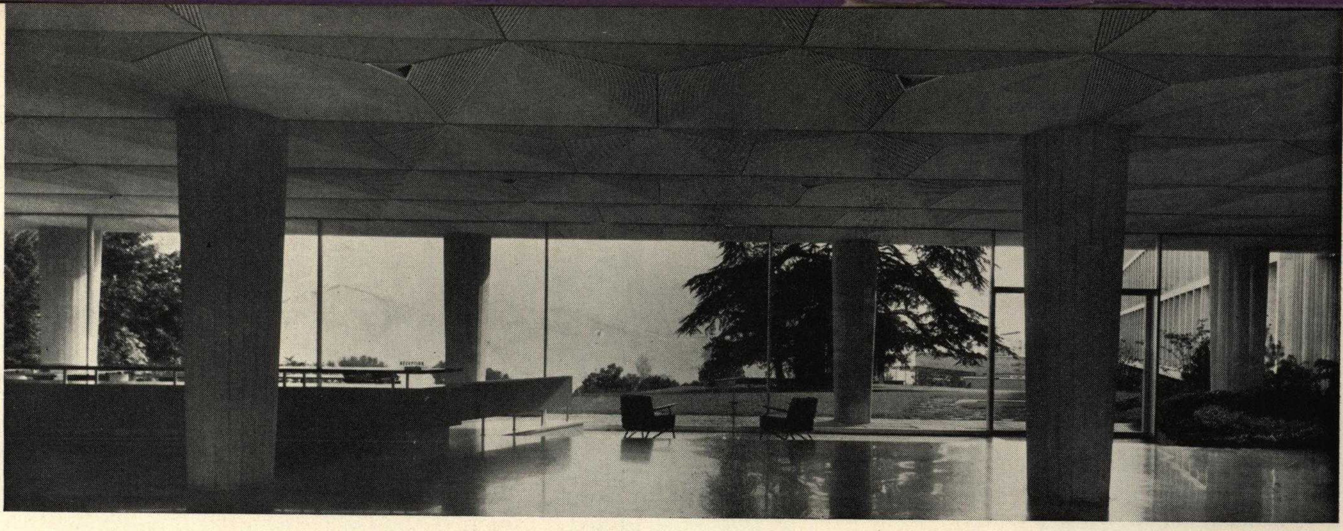
The focal point of the building is a tapered canopy of anodized aluminum which dramatically projects unsupported from the north facade. Beneath the canopy is a handsome transparent glass-and-aluminum foyer. The building is flexible in plan, all spaces being divided by removable aluminum partitions. The structure of the building is a reinforced concrete skeleton with concrete floors supported by a single row of cylindrical columns running lengthwise through the center of the building.

Aluminum solved two problems for architect Tschumi: soundproofing and sun protection. Perforated aluminum ceilings provide efficient acoustics. Exterior adjustable blinds with aluminum slats shade the building from the glare of the sun. In contrast to the white concrete and the light aluminum-and-glass facade, the interior of this building is constructed of rich dark materials in carpeting, furnishings and floors of Swiss marble.

It is in the consistent attention to human values that this building makes its contribution to modern architecture.

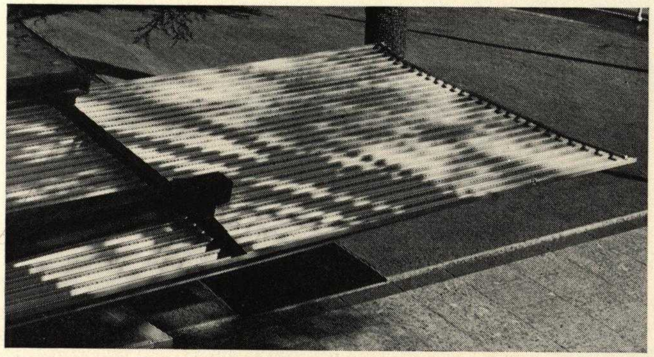


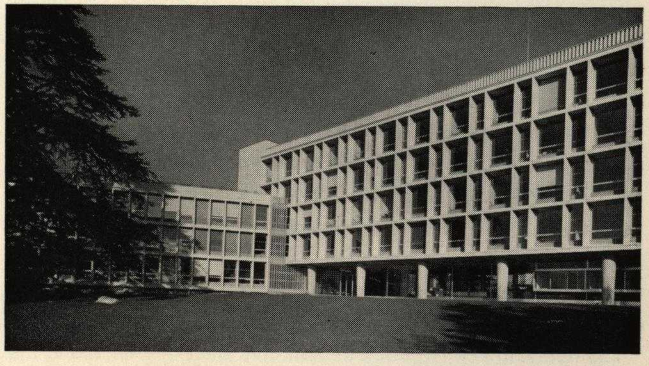
Right Here in beautiful and dramatic contrast is a modern European insurance office. Magnificent century-old cedars stand alongside a most modern cantilevered aluminum canopy sheltering a crystaline glass and aluminum entrance-way. Set in a Lake Shore park, the windows have extra low aluminum sills so that the occupants can better enjoy the view.

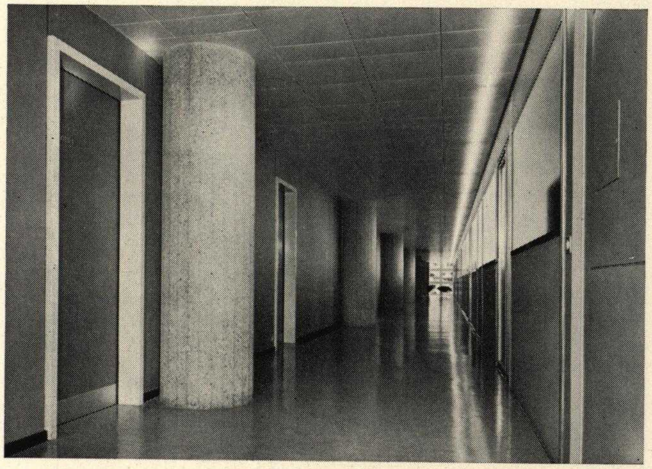


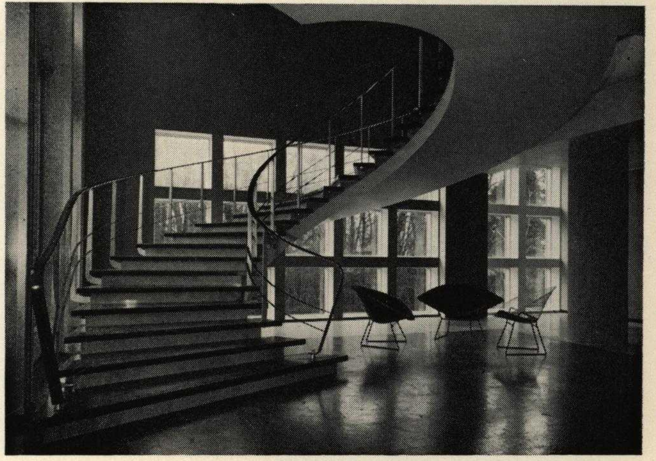
Above The main lobby for its entire length has a view of the lake provided by the full glass aluminum framed windows on the north and south facades.

The ceiling has an attractive hexagonal pattern. The concrete columns **are fluted** and tapered for decorative effect.









Above The top side of the canopy is constructed of aluminum sections V-shaped to carry rain water off at the back. **Below** This hall shows the aluminum wall partitions and concrete pillars which support the structure. Corridors are sound-proofed with acoustical ceilings and rubber tiled floors.

Above As seen from the lake, the bold concrete wall shields the setback aluminum office windows. **Below** The spiral stairway with aluminum railing leading from the ground floor to the executive offices is typical of the dramatically planned and richly marbled interior of the building.

Chetwynd Apartments

Rosemont, Pennsylvania, 1956

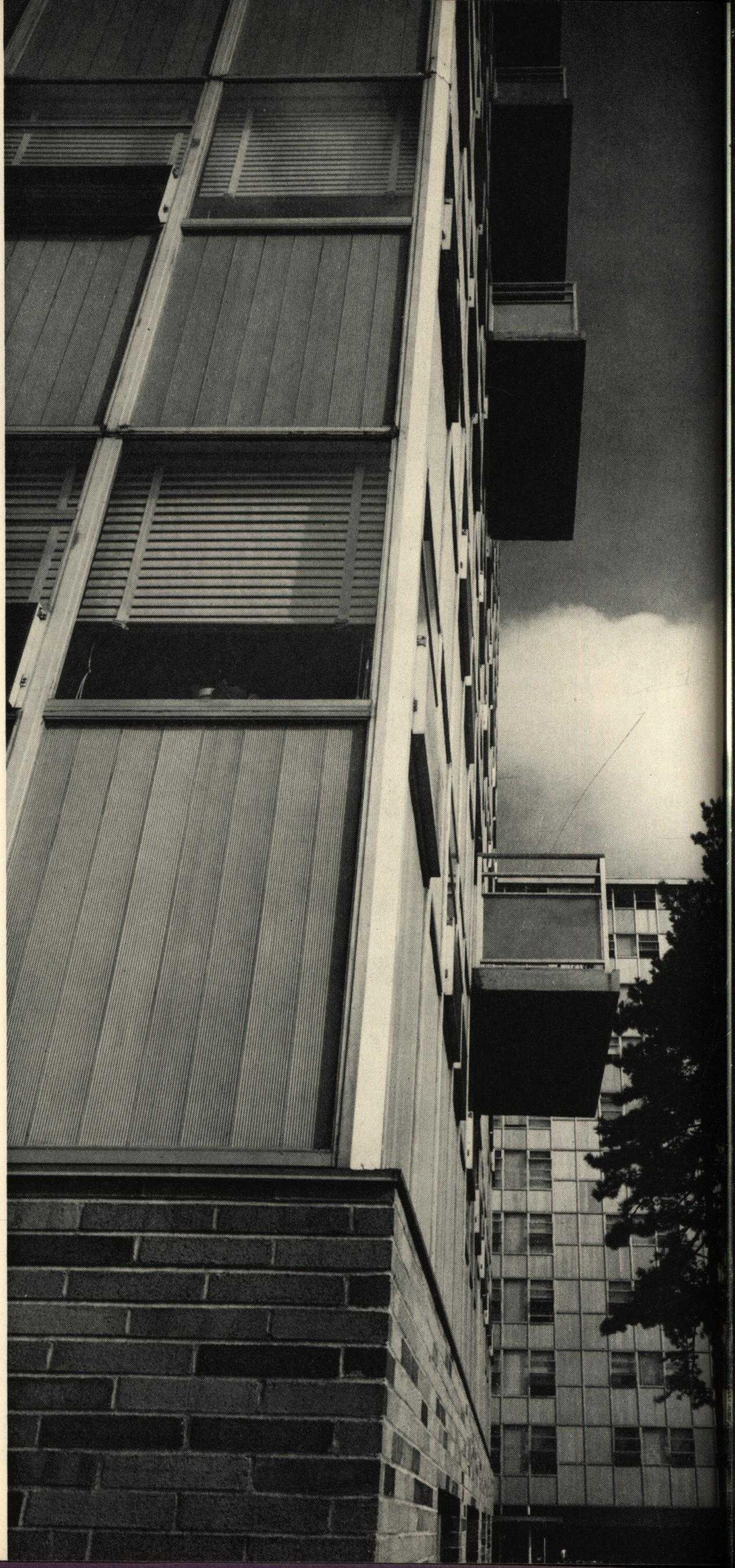
Charles Frederick Wise

Set on a twenty-eight acre sloping site surrounded by trees, this ten-story building is distinguished by an unusually critical cost requirement, an all-aluminum exterior skin, and a special cantilevered construction. The first F.H.A. Title 207 project approved with an aluminum skin, the Chetwynd Apartments had to be designed to be economical from the point of view of both construction and maintenance.

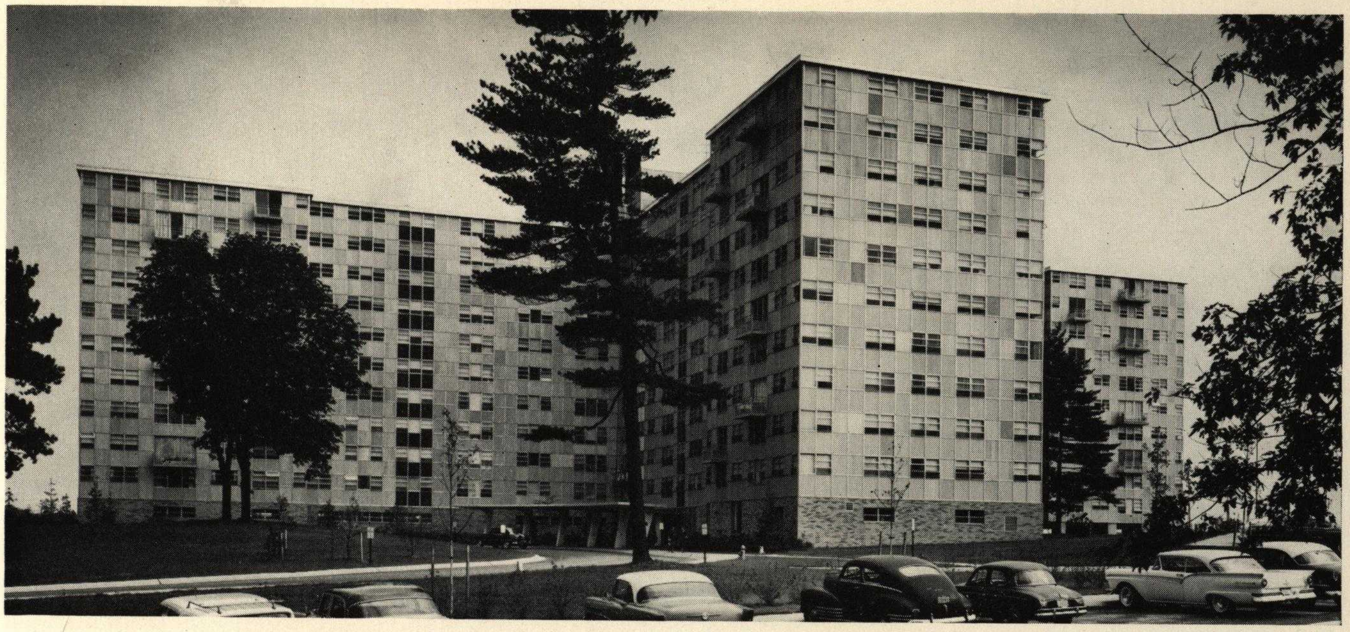
Pennsylvania Architect Charles Frederick Wise, working in collaboration with his structural engineers, succeeded in developing an aluminum skin which was installed at a cost comparable to that of an ordinary wall. The economics achieved by exterior walls cantilevered eight feet beyond the concrete bearing wall were made possible by the extreme lightness of the aluminum skin, which requires a minimum of structural support.

To obtain the maximum number of apartments on each floor with a minimum amount of wasted space, the architect constructed this apartment house on the plan of a cross. It gave the building its distinctive appearance and made the parklike grounds easily accessible to the tenants.

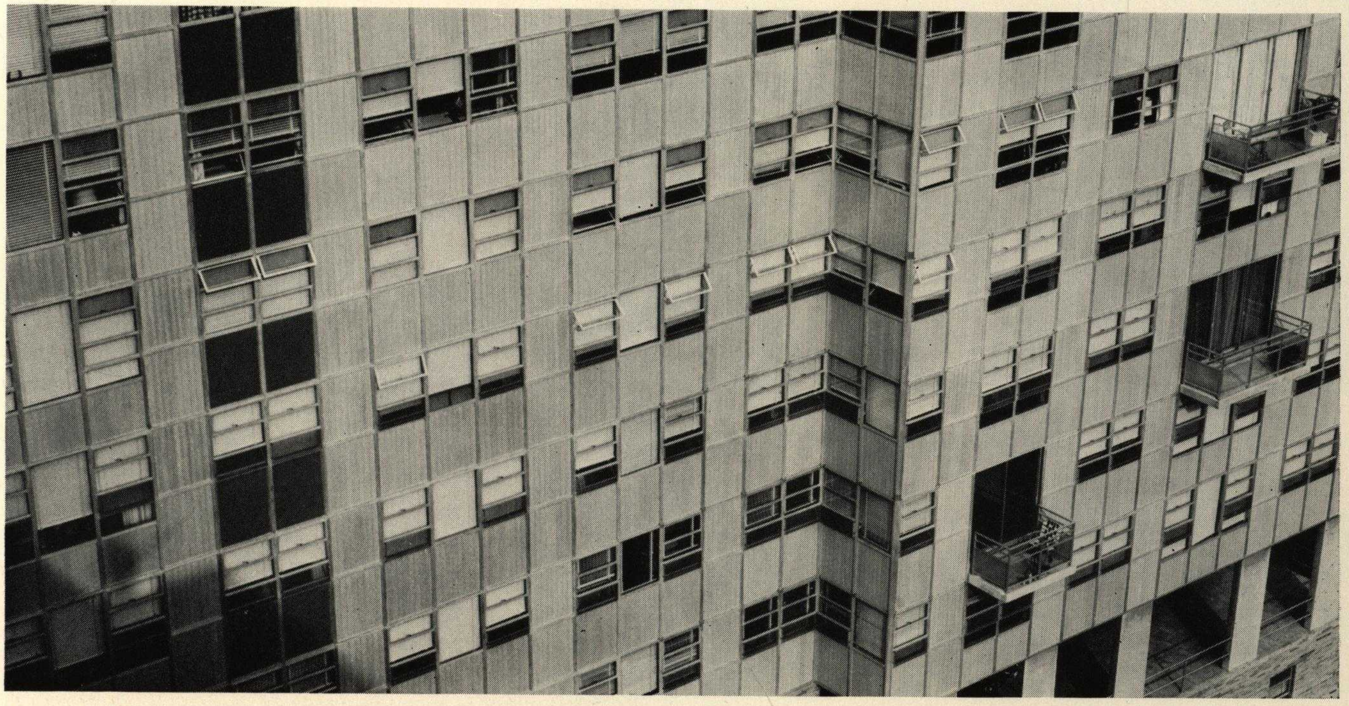
The noteworthy integration of economy and good design in the Chetwynd Apartments affords its elderly, retired, and fixed-income people the comfort and conveniences of a country estate.

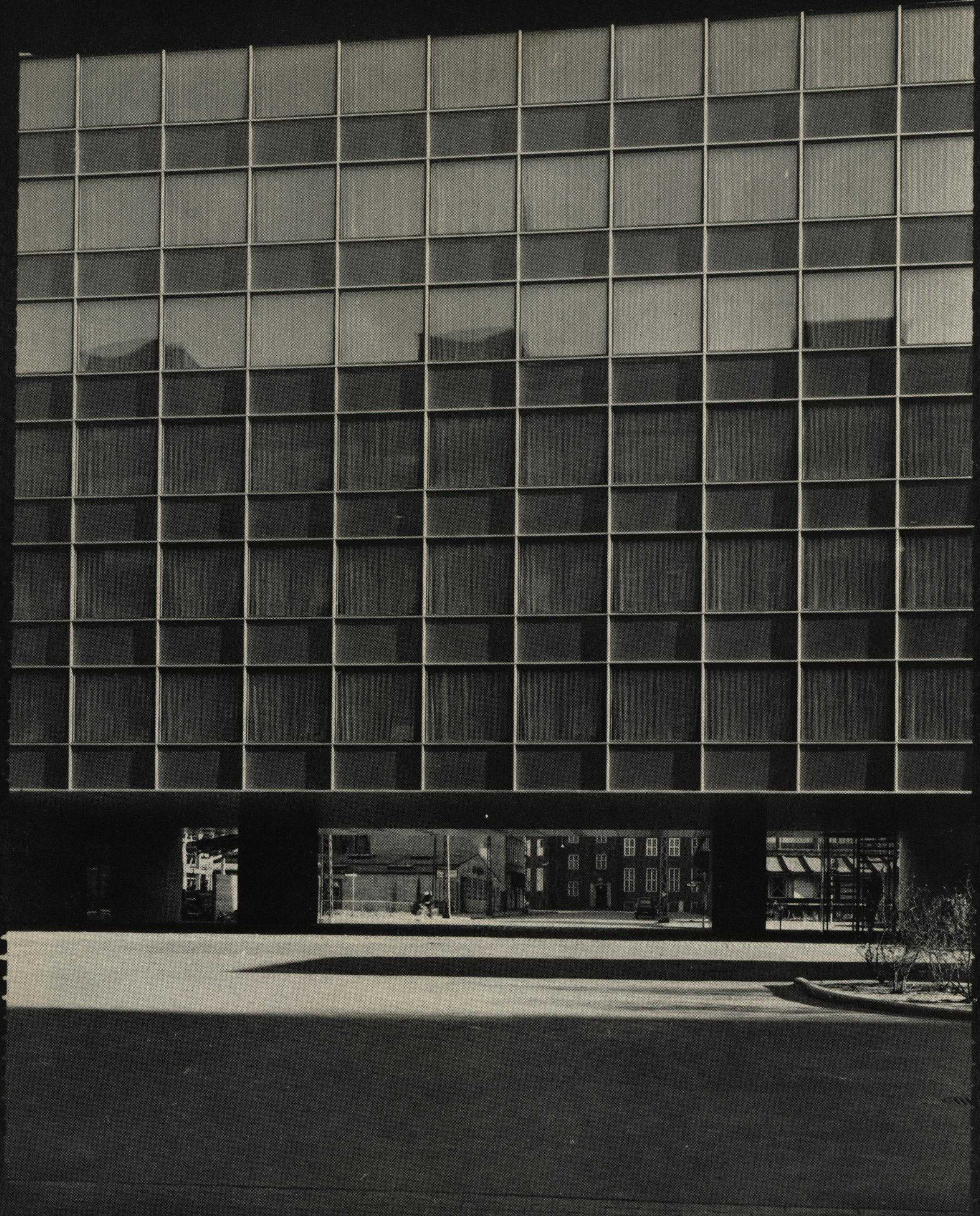


Right The aluminum skin wall is cantilevered 8 feet beyond the columns. The columns are actually bearing walls 8 inches wide and 4 feet or 5 feet long. The apartments are designed so that these bearing walls are used as partitions. Projecting balconies permit tenants to enjoy the park-like view.



Above This view of the apartments reveals the cross-type plan with convenient access to the 27 landscaped acres. **Below** The aluminum skin is hung from the edge of the cantilevered concrete slab. Backed with 3-inch insulation, it is finished on the inside with dry-wall construction.

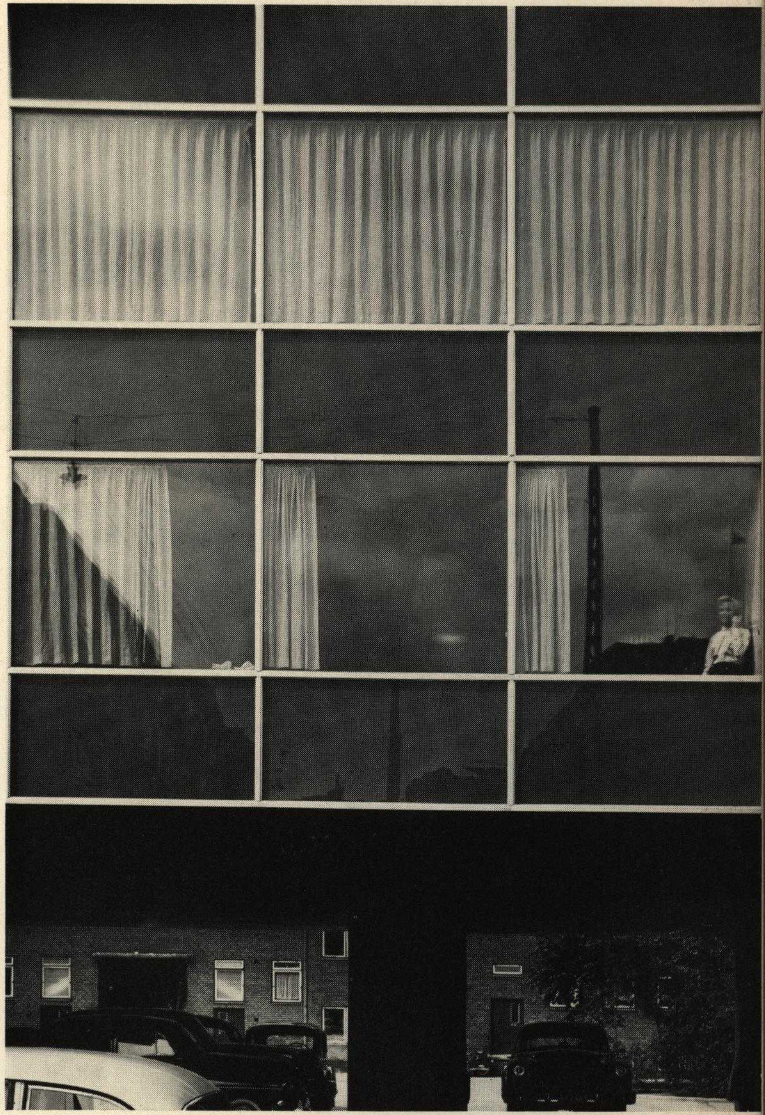




A. Jespersen & Son Offices

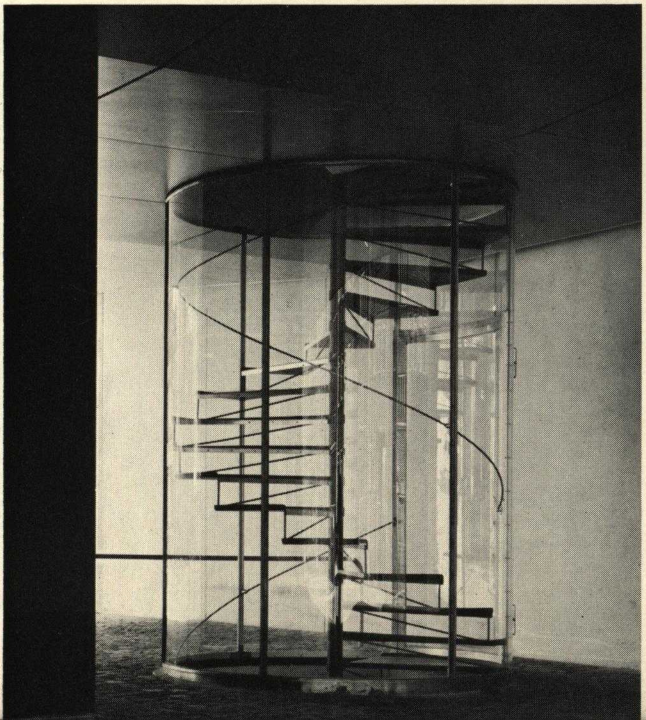
Copenhagen, Denmark, 1956

Arne Jacobsen



This site between two already existing buildings in the crowded city center of Copenhagen would have been a first-class challenge to any architect. Arne Jacobsen turned it into a first-class opportunity to design one of the most distinguished modern buildings in Denmark. He lifted the entire building off the ground on two pairs of columns running from the basement to the roof. Reinforced concrete slabs project on both sides to support precisely designed aluminum and glass curtain walls. The open ground floor provides parking space for tenants — a convenience that is becoming increasingly important in a prospering Europe.

The building is divided vertically into two sections. The first section contains offices with movable walls designed on a modular system. The second accommodates the stairways, elevator and toilet facilities along the solidly enclosed side. On the top floor there is a cafeteria and a terrace. From top to bottom, this is a building to be admired.



Far Left Seen from across the street, the mirrorlike glass and aluminum facade of this office building reflects the neighboring buildings. The two pairs of concrete pillars which support the entire building stand unobstructed at ground level. **Top** This beautiful glass wall shows the modern Danish craftsmen's famed skill in silverwork and cabinetry. Windows are fixed in this air-conditioned building. **Left** Here is a spiral staircase that has a refinement comparable only to modern abstract sculpture.

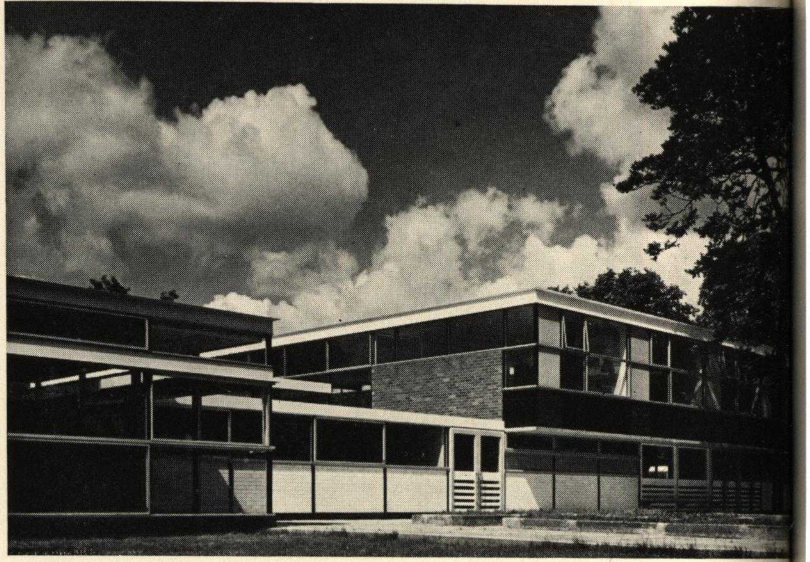
The Bousfield School

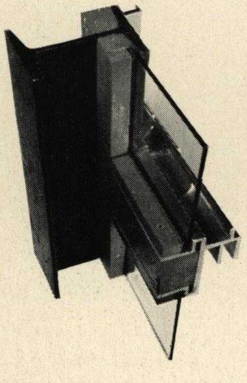
South Kensington, England, 1956

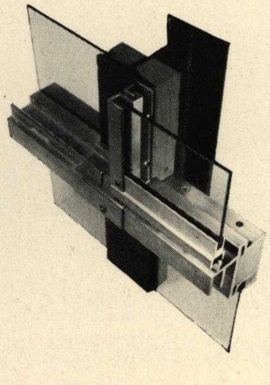
Peter Chamberlin, Geofrey Powell & Christof Bon

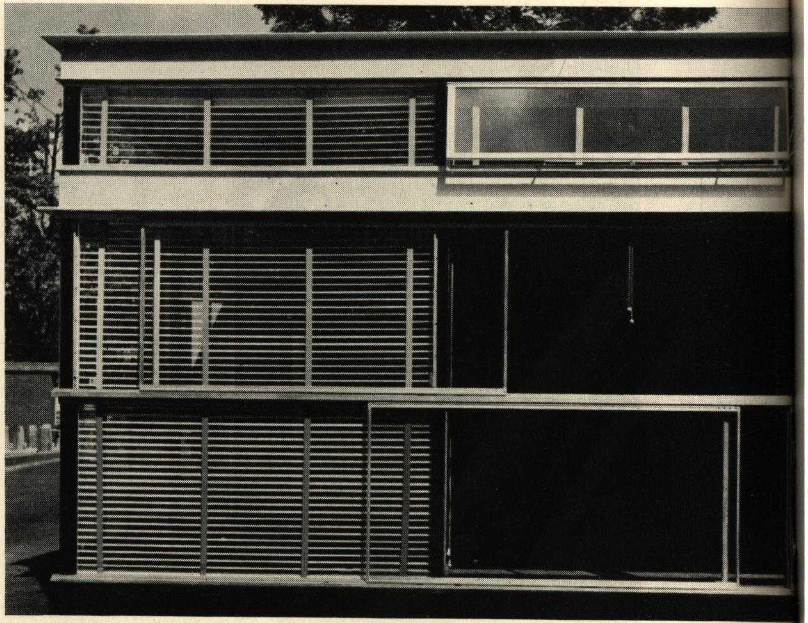
London's Bousfield County Primary School, built on a World War II bomb site, is one of the most satisfying examples of Great Britain's celebrated prefabricated school program. The school, imaginatively conceived as a pavillion in a garden setting, is designed according to the best modern tenets.

In designing this structure the architects, Chamberlin, Powell & Bon, departed from conventional school planning. The structural steel frame which provides the principal support for the school is left exposed. Though it does not conform to London's fire regulations, this feature was permitted by the London County Council on the grounds that it was experimental. The aluminum and glass which provide the elegant external wall of this school are displayed to their best advantage by being closely integrated with the structural frame. The curtain walls, the frame and the wood-wool roof panels of this factory-built building were rapidly assembled on a concrete and brick substructure. The Bousfield School demonstrates the role that light metals can play in the transition of educational buildings from a craft to a major industry.

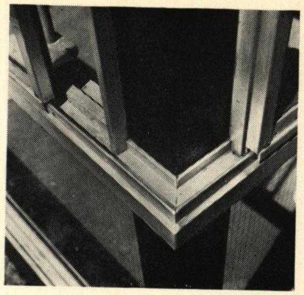


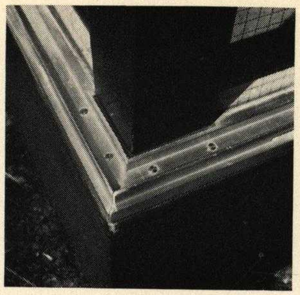




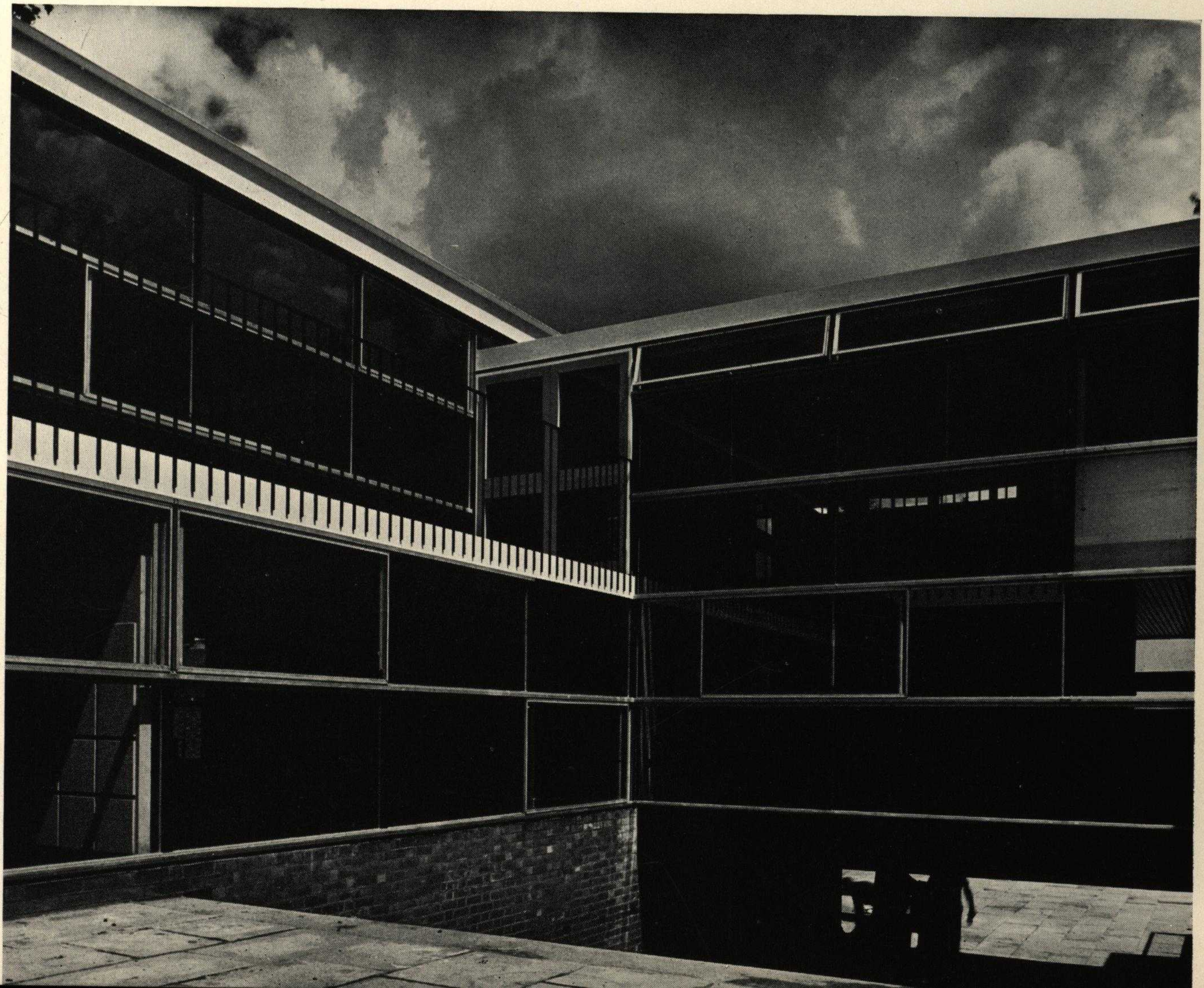


Top East elevation of the school reveals the entrance and nursery school. **Above Left** Cross-sectional mock-up shows clearly the joint between the steel mullion and aluminum transoms. The sliding sash runs on a felt-lined track and its vertical edges engage with a felt-lined aluminum chanel screwed through the flange to a softwood batten fixed through the web of the rolled steel joist. **Above Right** Viewed from the other side, the mock-up reveals how the fixed glass is secured with beads screwed to the batten in the transom. **Right** The children's assembly hall, viewed across a courtyard, shows the trim windows and blinds.



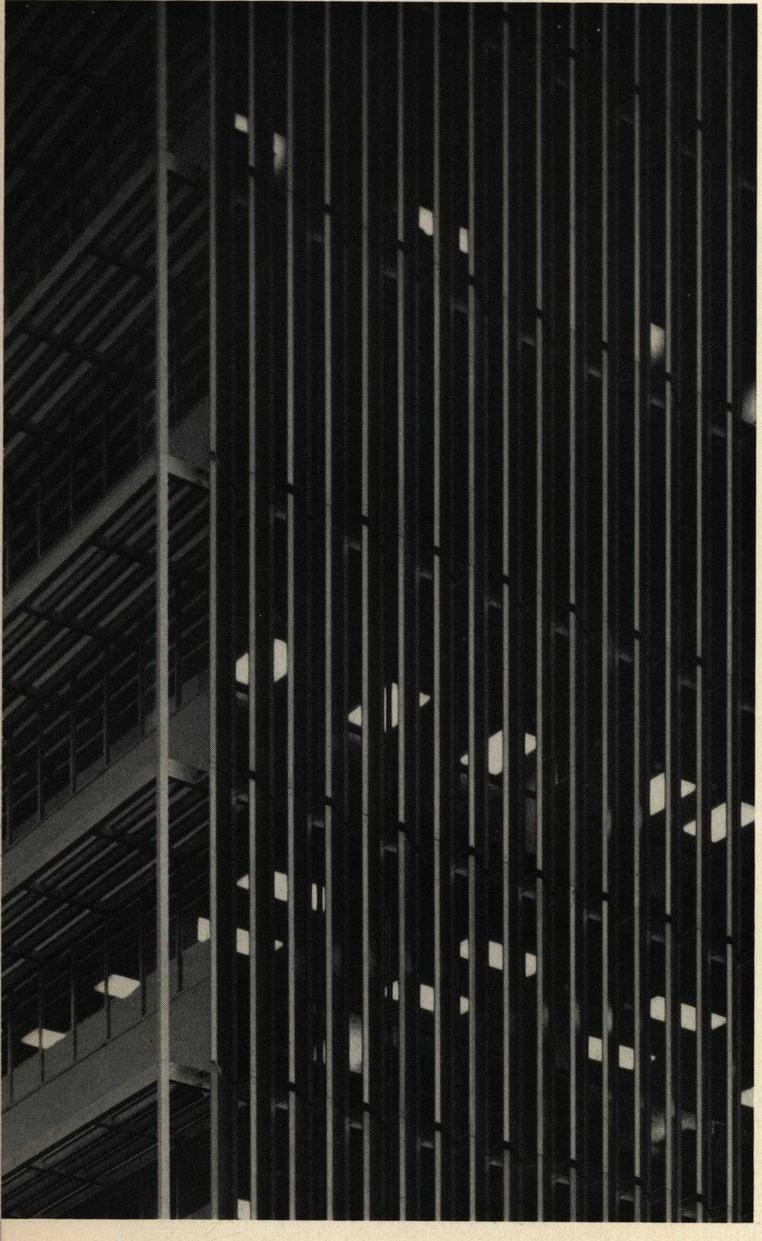


Top Four close-ups of various aluminum corner details. Left to right: the aluminum transom mitered around 3½ x 3½ steel angle stanchion; the aluminum and slate sills mitered round the bottom of the steel angle stanchion; the fixed glazing at the corner of the upper steel fascia showing the continuous aluminum window head member fixed to the fascia and steel stanchion; the corner of the siding windows and vertical aluminum stops which are fixed to the steel angle stanchion. **Below** View from inside the junior court looking northeast reveals the aluminum top hung vents and horizontal sliding sashes. The photos do not show the cheerful yellow, blue and green panels which add to the youthful gaity of this school.



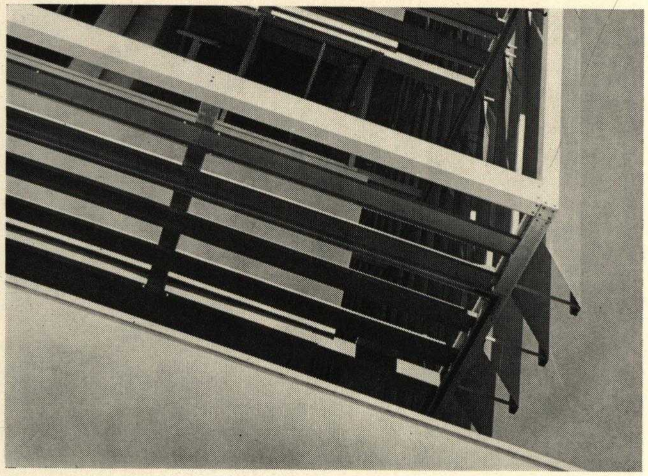
3325 Wilshire Building

Los Angeles, California, 1956
Victor Gruen and Associates

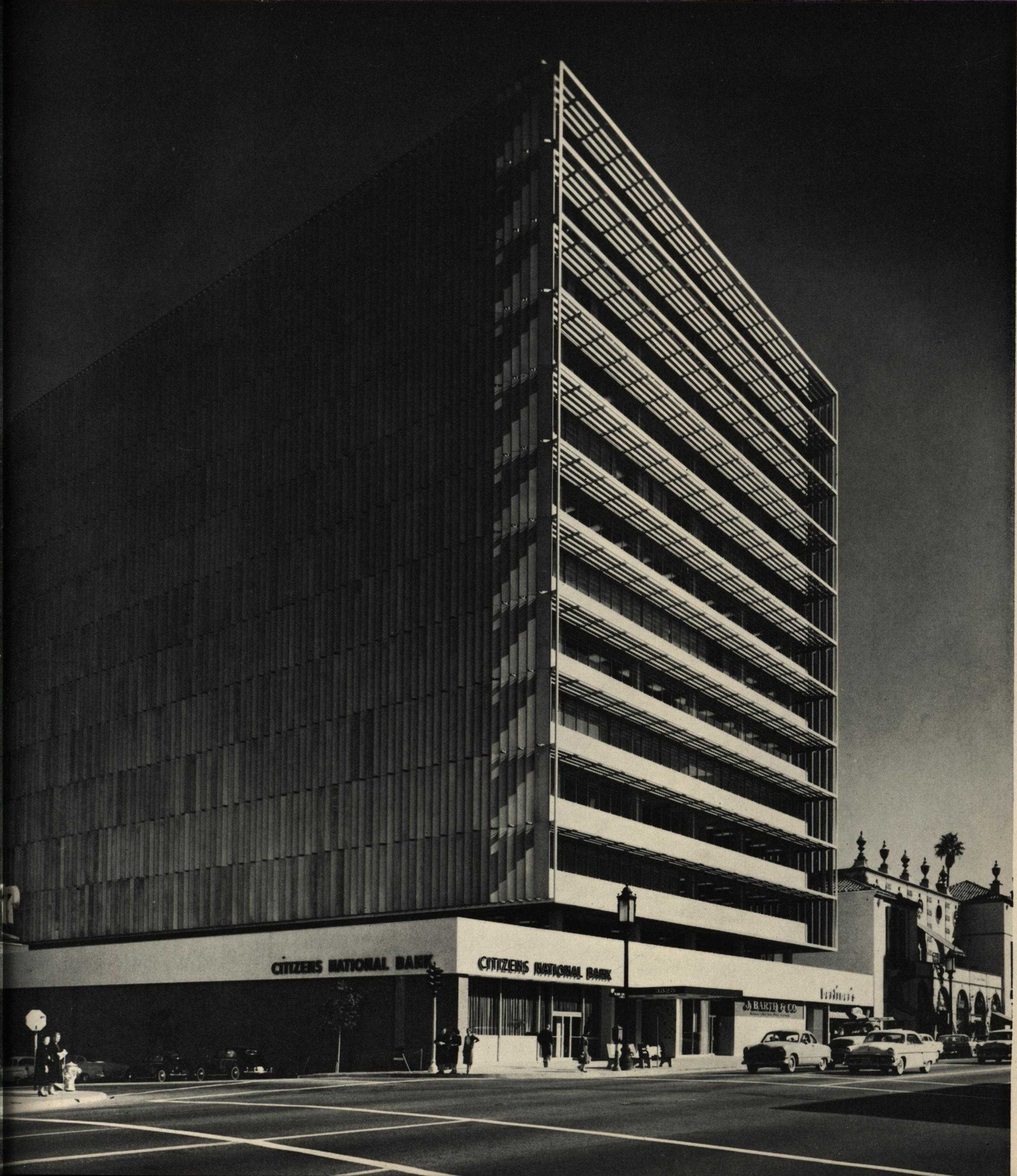


The Tishman Tower is a smooth glass tower wrapped in a sunscreen. This screen is made up of vertical aluminum louvers on the eastern and western exposures and horizontal eyebrows on the northern and southern sides. The system shades the building from direct sunlight, yet permits the entrance of natural daylight. It cuts down the glare from surrounding buildings and dramatically reduces the cost of air conditioning.

Architect Victor Gruen and Engineer Edgardo Contini have also reduced the total weight of the building. Lightweight structural aluminum was used for the screen. The development of a welded rigid building frame cut the weight of structural steel. Widely admired for these economical and engineering advances, Tishman Towers has also been cited for its contribution to the art of architecture—for the play of light and shadow and depth that has been absent from modern skyscraper architecture.



Left The aluminum louvers for sun and glare control give this 13-story building a lightness not often found in large office buildings. **Above** This close-up view of the Tower corner shows the horizontal aluminum sunscreen as well as some of the vertical aluminum louvers. The screen is fixed to outriggers on the exterior wall on all four sides of the building. **Right** The office tower rests on a broad reinforced concrete base which contains shops, mechanical equipment and parking space for 350 cars.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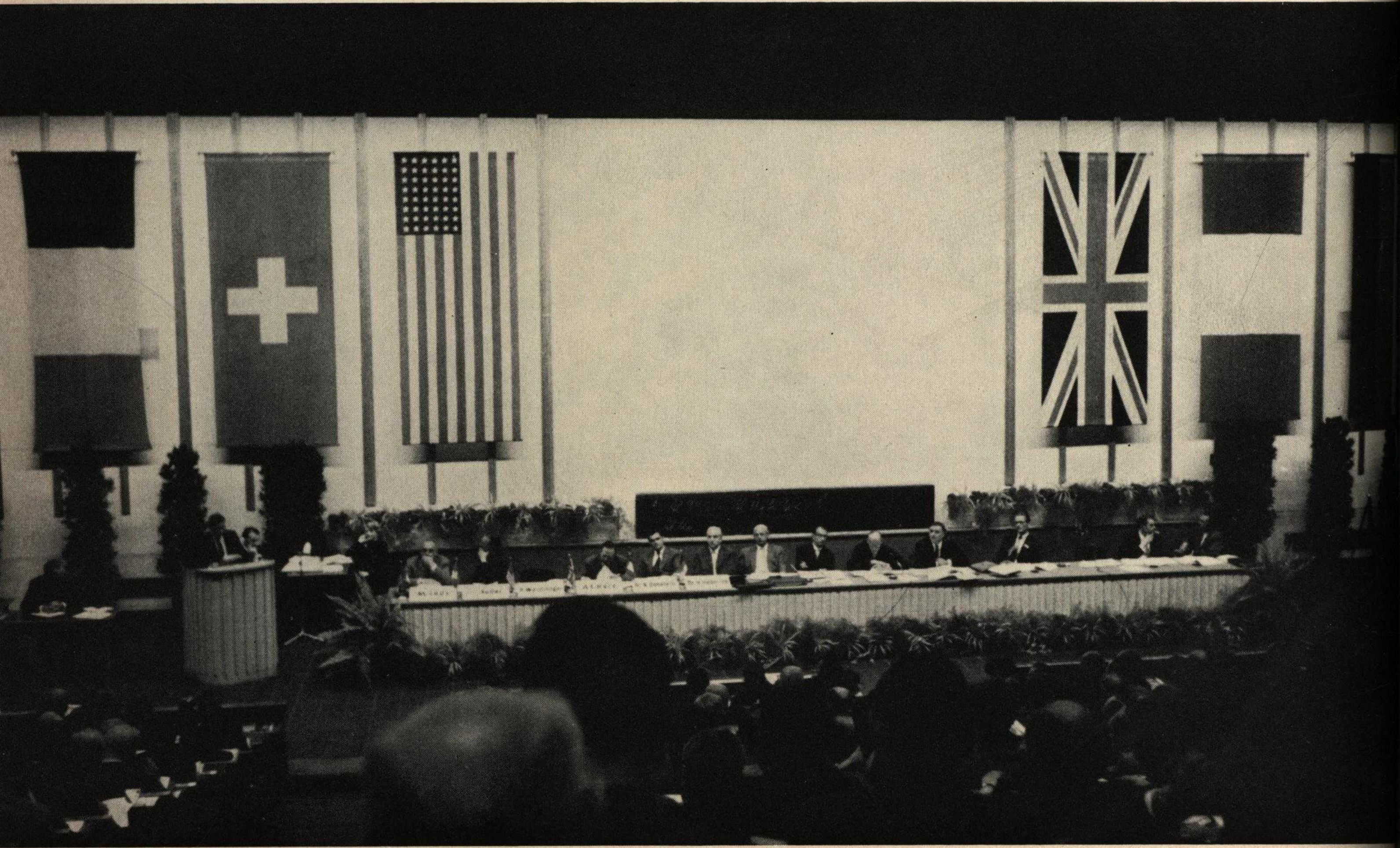
Aluminum in International Architecture

As this annual indicates, the increasing ingenuity in the use of aluminum as a building material is in no way restricted to this country. Without discounting the considerable contributions of the United States, which produces approximately 40 percent of the world's supply, it serves a useful purpose to survey technical developments abroad. An ideal opportunity was provided by the Conference on Aluminum in International Architecture held recently in West Berlin. Under the sponsorship of the Aluminum Zentrale, a panel of authorities was invited to report on advances in their respective countries. Like those attending the conference in West Berlin's Technische Hochschule, architects and engineers should find it both stimulating and profitable.



ALUMINUM CURTAIN WALLS IN THE USA

P. Weidlinger

P. Weidlinger, Consulting Engineer, has been Chief Engineer of the Bureau of Reclamation of Bolivia and Division Director of the U.S. National Housing Agency. Mr. Weidlinger has designed structures in the United States, South America and the Far East and has also designed guided missile sites and airbases here and abroad. Writer of numerous technical papers Mr. Weidlinger is the author of Volume II of "Aluminum in Modern Architecture".

INTRODUCTION

The metal curtain wall and spandrel wall represent one of the more recent developments in the building field. This building component, typically replaces the traditional non-bearing masonry panel wall and therefore must satisfy the very same, and familiar functions. There are basically two types:

a) The self contained curtain wall.

b) The curtain wall with masonry back-up.

The first type consists of an exterior facing, typically sheet metal, an insulating and/or structural core material, and an interior facing. In the second type the interior facing is replaced by a masonry wall. The structural integrity of the wall is provided:

a) through the interaction of the exterior face, core and interior face forming a bonded structural sandwich panel;

b) through structural members, stiffener or corrugations provided in either or both facing panels;

c) through independent framing members inserted between adjacent panels.*

These panels are fabricated in large units and are erected by connecting them to each other and to the structural frame of the building.

At the present time three metallic materials are used in the USA:

Aluminum (unprotected, anodized or enameled)

Stainless Steel

Carbon Steel (protected)

Most of the conclusions which can be made about this construction apply to all three materials. Aluminum has certain advantages which make it currently the most preferred curtain wall material. These are:

Light weight

Corrosion resistance

Superior fabricating characteristics

In addition to these, at the present time, periodic steel shortages and the increasing cost of steel, contribute to wide use of aluminum. Other advantages, such as its long term price stability and its high scrap value are probably not contributing as yet significantly to the popularity of aluminum. With increasing use however, these will very likely also be considered in the selection of the material. The cost of aluminum on weight basis is significantly higher than that of carbon steel, but it is lower than that of stainless steel. Due to its poor resistance to atmospheric corrosion, carbon steel is rarely used, except in enameled form. Aluminum sheet is cheaper than either enameled or stainless steel sheet.

Light weight curtain walls are a typical development of the skyscraper construction. This does not mean that it does not find its applications in structures of more moderate height, but it is clear that only the technological and economical demands of skyscraper construction could compel the notoriously conservative building industry to accept, practically overnight, this revolutionary advance in construction technique.

The last tall building with bearing walls in America was built in 1893 in Chicago. This 16-story building carried the floor loads at its base with 15 foot thick masonry walls. The advent of the steel skeleton forced the conventional brick masonry from its active structure role into a useless dead weight, to be carried by the steel structure. Even as late as 1931 the tallest skyscraper of the world, the Empire State Building in New York, was built substantially with 12″ to 10″ masonry curtain walls, the total weight of which is estimated at 30,000 tons.

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*Constructions of the type in which the total structural resistance is provided by the masonry back-up are usually not classified as metal curtain walls, but are termed masonry walls with metal facing.

Nevertheless both the Empire State Building and, two years earlier, the Chrysler Building, incorporated the first large scale attempts at the utilization of sheet metal as a partial facing material. Today, in this field it is only of historical interest that the Empire State Building uses 1-story high 18-gauge sheet-metal column and mullion covers (with a 6″ airspace) bolted to metal brackets and backed up with 10″ of masonry. This solution, which today appears to us as a rather primitive one, nevertheless shows the early recognition of both advantages and the technological problems which arise out of the application of metal curtain walls.

ADVANTAGES OF METAL CURTAIN WALLS

The advantages which a successful spandrel or curtain wall can present are quite compelling and obvious to designers of tall commercial structures:

1. Weight saving
2. Floor space saving
3. Speed of erection

Let us take a look at these advantages quantitatively:

1. Conventional brick masonry walls with plaster or furring weigh from 100 to 175 lbs. per square foot. The metal spandrel wall (if no back-up is required) will weigh from 5 to 15 lbs. per square foot. This means a weight saving of 85 to 95 percent above the conventional masonry construction. If we consider that the weight of the floor construction (including finishes) in modern steel structures can run as low as 50 to 60 lbs. per square foot of floor area, then the weight of the exterior wall construction, especially in the typical narrow (50 to 60 feet wide) tower floors becomes an important part of the total dead load to be carried. As a matter of fact, the conventional masonry wall may contribute as much as an additional 50 to 100 percent to the dead loads.

The weight reduction that can be achieved through the use of light weight spandrel walls therefore is a very important item. For tall skyscrapers it shows a cumulative effect. Aluminum walls of course show up especially well in this regard.

2. A similar reasoning can be applied to the savings in effective floor space. The typical masonry spandrel is 12″ to 18″ thick. The metal wall may be as thin as 2″ or as much as 8″ with backup. It has been estimated (Ref. 1) that the slight reduction which can be achieved in the dimensions of the building due to the lesser dimensions of the metal wall construction may add up to $9.00 to $18.00 per linear foot of wall for each floor. Considering the tight economy under which certain buildings are constructed, this amount can be of significance for multi-story buildings. The capitalized gain in 10 years due to added rentable space exceeds in some instances the first cost of the panel.

3. The last of the three items mentioned is the least suitable for numerical comparison. In the American economy, the speed with which a building can be completed is of paramount importance in view of the large revenue loss in rental which even a single day of delay can represent. The size of commercially used metal wall panels varies from 10 to 100 square feet per unit. The size is limited only by the weight and the ease with which the panel can be handled. Erection and fastening is usually accomplished using bolts or clips. These operations, compared to standard masonry erection techniques, assure an advantage in the erection time, which by informal observations has been estimated to represent a factor of 5 to 10 in favor of metal panels for an equal expenditure of site labor.

It is clear that all the above discussed advantages (and some other ones, which are claimed such as lower maintenance and better insulating capacity) must express themselves in terms of lower costs, in order to justify the application of these metal walls. The fact is, that at the present time metal curtain walls are costlier than masonry walls. It is also a fact, that the vigorous developmental efforts to improve conventional masonry techniques have succeeded in narrowing down the gap of technological advantages outlined above. That, in spite of this, we are experiencing a continuous and phenomenal rise in the use of metal spandrel and curtain wall construction is one of those wonderful paradoxes of the American economy, which cannot be dealt with in a paper concentrating primarily on technical aspects. We will come back later to the question of cost, but first let us survey the general requirements which the curtain wall has to satisfy, before it can compete with more conventional building components.

REQUIREMENTS AND SOLUTIONS

Any attempts to set up requirements may suffer from being incomplete or it may involve itself in belaboring the obvious. There is also the tendency to attempt to compete with the conventional material, in items which have no objective meaning, in terms of a radically new departure, or to satisfy the requirements which have nothing but tradition to recommend them. Some such requirements have to be met nevertheless since they are enforced by law. A case in point, of course, is the building code. American codes are numerous (at last count we had about 2000 of them) and many are fairly antiquated and irrational:

1. Fire Resistance.

The most difficult hurdle which the developers of curtain walls had to pass was and still is, our building code requirement regarding fire resistance of exterior non-bearing walls. Many such codes demanded that such walls had to resist a four hour fire test. The requirement has been reduced recently to two hours in most urban areas, and even to one hour in some. In either case, the irrational aspect of the legalistic interpretation of these provisions becomes evident if it is considered, that exterior walls made entirely of transparent glass will always be permitted, even though such glass walls will not meet any of these requirements. On the other hand, if any of the transparent glass panels is replaced by any other material, it must immediately meet the abovementioned fire safety regulations.

This situation has delayed and impeded the progress, but could not prevent it. The ingenuity of the designers came up with the solution which consisted of a metal curtain wall which is "backed-up" by 4″ to 6″ of masonry satisfying the legally required fire test. This solution of course has obvious draw backs and reduces the inherent advantages of the light weight metal wall.

2. Moisture Condensation.

Another interesting and difficult problem arose out of the desire to prevent moisture condensation at the inner face of all-metal panels. Any through-metal contact between inner and outer metal face produces cold spots in the inner facing, which in turn result in condensation. While such moisture is considered normal and not objectionable in standard American single-glazed windows, the very same phenomenon was believed to be not acceptable on any parts of the panel. A great deal of cost, effort and ingenuity went into the finally successful attempts to solve this problem. The fire safety regulations requiring the masonry back-up, however, in this case also helped the designers by resolving as a by-product the problem of through-heat conductance and concommittant condensation.

3. Thermal Insulation.

The problem of thermal insulation was easily solved. The back-up masonry material itself again can serve as insulation if special lightweight insulating blocks are used. In addition to this, (or instead of the insulating back-up) various insulating "core" materials are available which provide equal and in most cases better insulation than conventional construction. A heat loss of only 0.15 BTU per hour can easily be provided and panels exhibiting a heat loss of only 0.05 BTU per hour can be produced. Aluminum panels of course can provide additional reflective insulation with a simple air space at no additional cost. The following table reproduced from Ref. 2, indicates the scope and properties of the currently available core materials in the USA:

4. Sound.

Soundproofing and sound deadening represent a problem which varies in importance with the intended use. Sound deadening against impinging of rain and wind on the exterior metal face is usually achieved through the effect of thermal insulation used, or if needed, special sprayed-on materials are used. The same means usually also provides sound attenuation of 25 to 50 db.

5. Joints.

The joining and fastening of panels represents one of the more difficult objective technical aspects of the metal curtain wall construction. The joint between panels has to be weather tight, and should avoid through thermal conductance. The details of these joints and connections have to satisfy the following requirements:

a) Simple and speedy erection;

b) Ease of replacement of damaged panels;

c) Clean appearance of joints.

Anyone who has undertaken the design of such panels can testify to the extreme difficulties which arise out of these relatively simple criteria. In fact, it may not be an exaggeration to state that at the present, there are probably only two choices available: Either the requirements are not fully satisfied or the designer (and user) have to reconcile themselves to a rather complex, cumbersome and costly detail. At this point the availability of extruded sections, which can provide at a very low cost a rather complex cross section, becomes very important, and the superiority of aluminum alloys becomes quite apparent. It may not be surprising if for this reason alone in the future aluminum alloys will replace other metals in curtain walls.

There are two basic types of joining methods used at the present:

a) Direct connection of adjoining panels, either by lapping or by "male-female" and tongue and groove edges. In either case, it often becomes necessary to provide a separate cover plate to improve both the appearance and weather tightness of the joint.

b) Indirect connection, by means of a narrow spline or "filler" panel to which both adjacent panels are connected in identical manner.

In this type of application, the "filler" itself often serves as a cover plate, and it may also incorporate main or auxiliary framing members for the panel itself.

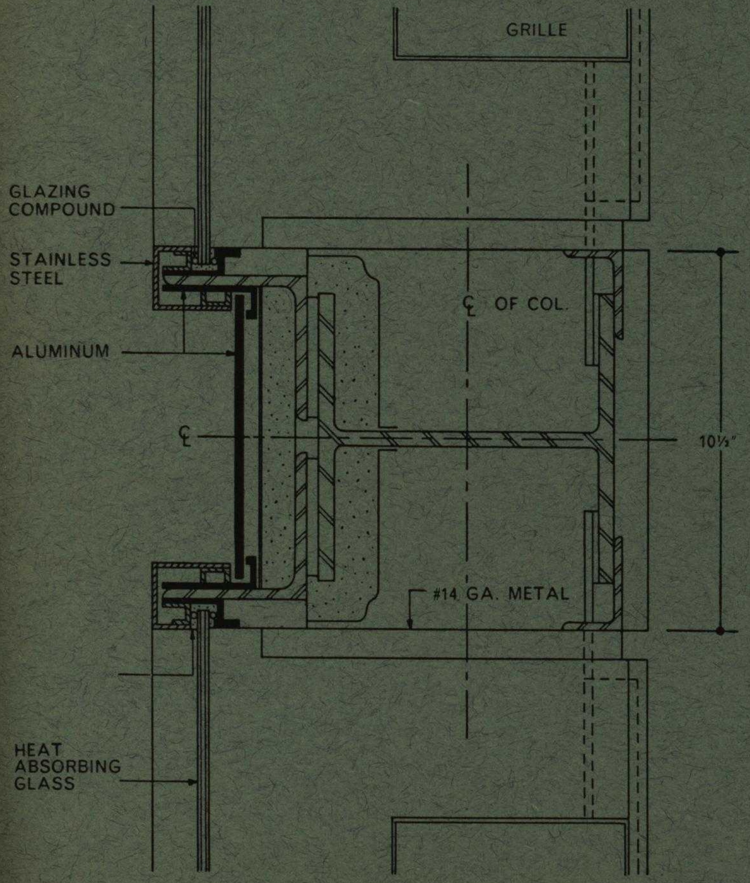
CORE AND INSULATION MATERIALS

Material	Weight[1] Pounds	Available Thickness	Available Sizes	Conductivity Btu per inch	Moisture Resistance	Fire Resistance	Thermal Expansion	Cost[1]	Remarks
Gypsum board	5.23	½″ to 2″	4′x8′,10′,12′	1.41	Poor	Incombustible		12¢	
Asbestos-cement with fiberboard core	3.75	11⁄16″ to 2″	4′x6′,8′,9′, 10′,12′	.40	Fair (expands)	Incombustible	Negligible	40¢	
Mannite (calcium silicate)	3.00	½″ to 2″	4′x8′,10′,12′	.75	Poor	Excellent	Negligible	High	
Cemented excelsior	2.3	2″ to 3″	32″ wide	.45	Fair (expands)	Incombustible	Negligible	2″ thick–12.5¢ 3″ thick–11.0¢	
Foamglas	.75	2″ to 5″	12″ x 18″	.39	Excellent	Incombustible	Negligible	13¢	Vapor proof
Paper honeycomb with perlite fill	.7			.39	Fair	Poor	Negligible	16¢	
Cork board	.6	1″ to 6″	12″x36″ to 36″ by 36″	.26	Fair	Fire retardant	Negligible		
Fiberglas P-F 615	.47	1″ to 4″	24″ x 48″	.24	Good	Incombustible	Negligible	6.5¢	Batts resist fire to 450° Fibers resist fire to 1000°
Aluminum honeycomb	.4				Excellent	Incombustible	High	80¢	
Paper honeycomb	.3	to 4″		.58	Fair	Poor	Negligible	12¢	
Mineral wool	.25			.27	Fair	Excellent	Negligible	2¢	
Polystyrene foam	.16			.27	Fair	Self-extinguishing	Negligible		
Pumice concrete	8.0			2.42	Poor	Excellent	Small		
Penite concrete	2.6			.77	Poor	Excellent	Small		1 to 5 mix. Shrinks considerably in curing
Foam concrete	2.5			.6	Good	Excellent	Small	10¢	including material & labor
Vermiculite concrete	2.25			.76	Poor	Excellent	Small		1 to 6 mix. Shrinks considerably in curing
Sprayed Asbestos	.9	½″ to 2″		.26	Good	Excellent			

[1] per square foot 1″ thick; costs are approximate

The developing of joints for such panels, especially if a high degree of standardization is required simultaneously, with universal applicability, can become extremely complicated, due to the large variety of cases which need to be covered. Taking into account vertical and horizontal joints, connections to windows on all four sides, exterior and re-entrant corners, the number of conditions which have to be satisfied with a (preferably) single detail, may amount from 10 to 20.

Experience indicates, that the second type of joining method, using fillers may be the most suitable for this type of application. Horizontal joints have to be either extremely tight, or special gaskets are used to prevent the penetration of driving rain. Ordinary lap joints require 2-3″ of vertical overlapping which is about the equivalent pressure head measured for driving rain. In many instances, ventilation provided behind the exterior face of the panel permits the discharge of moisture which may have penetrated.



This detail of a typically modern American curtain wall was designed by Skidmore, Owings and Merrill for the Connecticut General Life Insurance Company's new office building in Hartford, Connecticut, USA.

The high coefficient of thermal expansion of aluminum presents special problems in joint design of long panels, and expansion joints or other devices permitting displacements need to be incorporated to avoid buckling of light gauge elements.

6. Structural Details.

The typical curtain wall or spandrel panel is not a load bearing element. The principal structural criterion is the resistance against wind pressure and suction. These forces, which in the USA are usually assumed to be from 10 to 30 lbs. per square foot, are to be resisted safely, without permanent deformation and with limited elastic deflections. The structural action of the panel can be classified according to the method through which the wind forces are transmitted to the structure. This is accomplished by the following methods:

a) Panels spanning horizontally between exterior columns, usually at a spacing of 18 to 40 feet.

b) Panels spanning vertically from floor to floor or from floor to intermediate horizontal girts. In this case the span is either 9 to 13 feet or 3 to 6 feet.

c) Panels cantilevered vertically from the floor in which case the cantilevered span of the cantilever will be the height of the window sill.

The ideal panel would be completely self-contained, and for this purpose the best solution appears to be the structural sandwich panel, in which the core material serves both for structural strength and insulation. Sandwich construction was developed originally for aircraft applications, but in several instances it has been used successfully in prefabricated buildings. The core materials may be those listed in Table 1, and additional data on such materials and design methods are given in Ref. 3. At present such panels are limited to a maximum dimension of about 12′ because of production equipment available. A 2″ minimum thickness is feasible for both structural and insulating purposes. These panels are probably the lightest available but at the present their cost is higher than that of other systems.

Corrugated panels, in which the corrugations provide the required resistance, are at the present most popular in industrial applications. Aluminum alloy panels, composed of connected and interlocking extrusions, operate structurally like the corrugations, but provide greater stiffness and a larger choice in the cross-sectional shape. These types are found in a great many commercial and institutional buildings and are at the present most widely used.

Since many contemporary buildings have large window areas, attempts are made to incorporate the window mullions and sills into the panel. These elements usually serve also as secondary structural members, either spanning from column to column or floor to floor, or providing a complete structural grid. In addition to the window sill, the radiator covers themselves can play a structural role. Some panels are fabricated to span two floors simultaneously, resulting in a reduced erection time. In such cases the light weight of the panel becomes of importance and in most such applications only aluminum is used.

Spandrel panels of cast aluminum are also employed in a few instances. Cast spandrels permit a rather complex surface texture and provide a great deal of rigidity. Cast panels are of course only possible in aluminum, since their weight would be excessive in other metals.

7. Exterior Panel Facing.

The exterior surface of the panel has to provide protection against the elements, it is to have favorable weathering characteristics, and finally it has to satisfy visual and aesthetic requirements. All these are relatively easy to satisfy with aluminum alloys.

At the present time the general practice is to use the following materials.

TABLE 2

	AA Designation	Comparable DIN Designation
Sheet Metal Panels	3003	A1 Mn
Extruded Panels	(6063	A1 Mg Si 0.5
	(4043	(A1 Si 5)
Cast Panels	43	(G A1 Si 5)
Fasteners	2024	A1 Cu Mg 2

Sheet aluminum panels use .032″ to .125″ thick materials, the most common being the .064″ thickness.

Both the sheet and extruded alloys have basically high corrosion resistance. In most instances, two coats of clear lacquer are used with a total thickness of 0.0006″. In addition to that, an oxide coating of at least 0.0008″ thickness is provided. A whole series of specialized finishes are available, which range from the standard mill finish to alclading. About 10 different types of chemical finishes, about a dozen electrolytic oxide treatments (also known as anodizing), as well as paints and vitreous enamels are currently used. (3). At the present time anodizing is the most popular method and a complete range of rigidly controlled colors is available.

In addition to color treatment, a series of textures is available through various types of corrugations, embossing and other mechanical finishes such as polishing and sand blasting.

The general experience is that, either completely flat panels or panels which include large flat areas tend to buckle to the extent that they present an uneven appearance. Recent studies (2) have indicated that the wavy appearance can be correlated to the maximum slope of the individual waves which appear in the panel. It was found that if the average slope, measured from the base line to the crest of the wave exceeds 1.00% in highly polished surfaces, and 1.25% in not polished surfaces, the appearance of the panel will be objectionable. In case of heavily textured finishes the permissible slope may be 2.00%.

While it is possible to control the flatness of sheet metal panels during fabrication and erection to satisfy the above requirements, temperature changes after erection may produce slight buckling with subsequent reappearance of the waves. For this reason the tendency is generally towards heavily textured panels or the more rigid extrusions and casting are used.

8. Economic Considerations.

It is not possible to estimate the number of buildings in the U.S. which use aluminum curtain walls, but it is clear that their number is increasing at an accelerated rate and at the present a substantial majority of tall commercial buildings in the design or construction stage use these panels.

A survey conducted two years ago by the Research Advisory Service of the American Institute of Architects disclosed a very wide interest in this new construction method. This survey also showed that the preferred use was indicated in the following order:

TABLE 3

Commercial	21.3%
Educational	17.0%
Industrial	17.0%
Hospitals	12.9%
Others	31.8%

Another significant finding of this survey was, the reasons for which the metal curtain wall was rejected:

TABLE 4

Reason Not used:	
Economic	44.8%
Aesthetic	19.1%
Code Restrictions	18.3%
Technical	17.8%

The above data emphasizes the most difficult problem in this type of construction: Namely, the relatively high cost. At the present time, it is extremely difficult to obtain reliable cost data. This is at least partly due to the reluctance of builders and contractors to disclose information which would indicate that (in first cost at least) these panels do not live up to expectations.

A rather dated cost study (Ref. 1) has shown that the basic first cost of an exterior wall consisting of 4″ of brick and 8″ of masonry back-up will cost $17.01 while the cost of aluminum spandrel walls varied from $14.89 to $27.73. With the tendency towards more elaborate metal walls it is certain that the cost ratio at the present may not be favorable. In the same study however it was shown that additional marginal savings are obtained by the use of metal walls, due to reduction of the structural cost (due to reduced weight), gain in rentable space (due to reduced thickness), reduced heating costs (due to reduced heat losses). If these additional savings are capitalized, it can be shown, that the long term capitalized cost of metal walls is substantially lower than that of conventional walls. It is however doubtful, whether builders and contractors base their decisions on such careful long term cost comparisons. In the American economy a considerable dollar value is assigned to the intangible benefits which arise out of the favorable publicity gained by the pleasing and in a few instances aesthetically highly satisfactory appearance of these new types of construction.

On the other hand, it is quite clear that these intangible advantages would soon be forgotten if the basic ideas behind metal walls would not be sound. The erection of these walls is very fast and the few years of experience have shown, that well-detailed aluminum curtain walls give very satisfactory, maintenance free service.

Proper methods of finishing ensure color fastness and several of these buildings (with a few notable exceptions) seem to have the ability to "age gracefully" without losing their original attractiveness. It is very likely, that further experiences and developments, will bring about additional significant improvements, and also will make aluminum walls clearly competitive even costwise with conventional methods. Aluminum spandrel walls do not appear to be a temporary stylistic innovation, but seem to become a permanent part of the contemporary architectural vocabulary.

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2. Curtain Walls of Stainless Steel; (School of Architecture, Princeton University, 1955)

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USE OF LIGHT METAL IN SWISS CONSTRUCTION

E. Muller

E. Muller, architect, received his architectural degree in 1935 at the Federal Polytechnic Institute in Zurich. After three years of affiliation with various Swiss architectural firms, Mr. Muller was selected as consulting architect to Switzerland's Aluminum-Industrie — A. G. Chippis.

Thirty years ago, on the occasion of preparing an exposition here in Berlin, Professor Walter Gropius said the following about the use of aluminum in architecture: "The advantages of aluminum that fit it for use in modern building are firstly its homogeneity, weather resistance, water repellency and rustproofness, secondly its susceptibility of precision fitting of parts, and finally, no less important, the beauty of surface that aluminum affords; so that the builder is freed from the necessity, as with iron, of masking his exterior with paint, but may gain the desired effect by the natural color and texture of the metal."

These few words, from his paper "Non-Ferrous Metals—The Building Blocks of The Future," would be difficult to improve upon, even today.

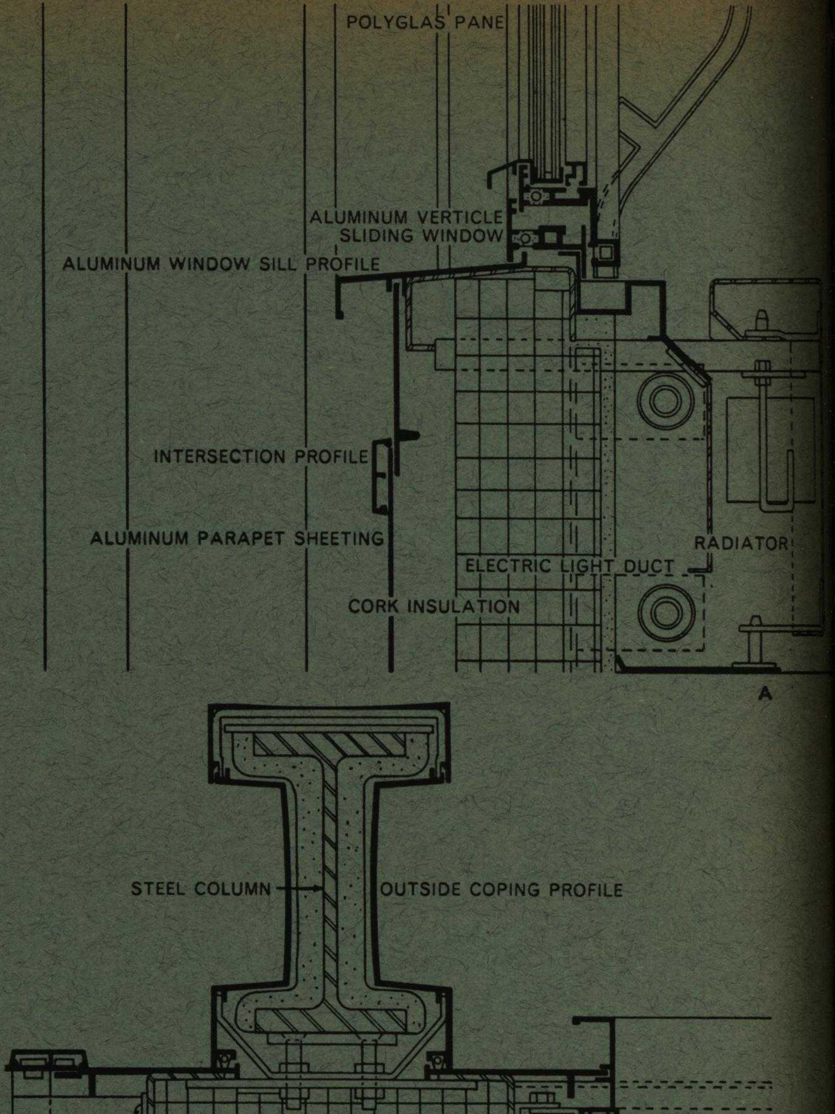
In Switzerland, there are three important areas of construction in which aluminum has had an active development not only qualitatively but also quantitatively, namely roofing, casements, and—in the last few years—mass-production facade units.

1. Roofing

The earliest attempts to use our alloy Aluman (Al-Mn) for roofs were made by the construction division of the Swiss Federal Railways (SBB) in the years 1931-32. All of the Aluman roofs then installed (for example Rapperswil station, Bern freight depot) are still in first-rate condition today. About the same time, a technical brochure appeared with instructions for using light metal in structural sheet-metal work. Incidentally, development in the thirties was much hampered by the general economic crisis as well as by price difficulties (very low price of copper). This situation was to change entirely in 1939. Aluman then became the only metal available without too much difficulty or restriction.

Aluman has since made an ever larger place for itself in the Swiss sheet-metal trade. The new roofing metal was intensively publicized and promoted by the Swiss trade association and its publications, in cooperation with the manufacturer, by issuance of instructions, brochures and sponsorship of installation and welding courses, and the like. What was achieved may be seen today in any number of projects and roof structures executed in Aluman on large and small buildings all over the country.

The commonest type of roofing in our country is what we call the double-fold type for gently inclined roofs, made of Aluman strip 670 mm. in width and 0.7 mm. in thickness, installed on spaced wood frame. For less thoroughly insulated industrial roofs and shed siding, much use is made of long Aluman corrugated strip, permitting uninterrupted cover from ridge to eave, and easily bearing on spans of about 2 meters. The Swiss architect Furrer's invention of the "Fural" roof has also had much success. This employs long rolled strip with swallowtail corrugations such that the rolls can be unrolled on the roof in horizontal direction and fastened without perforating the metal.


POLYGLAS PANE
ALUMINUM VERTICLE SLIDING WINDOW
ALUMINUM WINDOW SILL PROFILE
INTERSECTION PROFILE
ALUMINUM PARAPET SHEETING
RADIATOR
ELECTRIC LIGHT DUCT
CORK INSULATION
A
STEEL COLUMN
OUTSIDE COPING PROFILE
VENETIAN BLIND GUIDE RAIL
WINDOW AND MOVABLE FRAME OF VERTICAL SLIDING WINDOW
B

These two details of windows and columns designed by talented architect Hans Hofmann for the Zurich Administration Building of the Swiss Aluminum Industry shows an effective use of aluminum extrusions.

2. Casements

The process of extrusion makes possible the fabrication of the most complicated of sections. It was developed and refined to a high degree over the past twenty years in Switzerland, particularly. It makes aluminum and especially its alloys, for example Anticorodal (Al-Mg-Si), ideal for casements, since sections can be prepared with comparatively simple equipment to ensure the utmost tightness and stability of frames and permit pleasing and graceful designs.

Mechanical corner fastenings with screws, rivets or clips are giving way to electric welding. All major Swiss metalworking firms now have efficient corner welding machines. Vibration endurance tests at the AIAG research institute in Neuhausen have established that the welded corner connection is superior to mechanical fastenings in strength and watertightness. For large casements, we generally use hollow sections with favorable moment of inertia.

3. Facades

Now that the solid masonry wall has been replaced by steel or reinforced concrete skeletons, facade design has undergone many changes. The same problems of planning the non-supporting envelope that you are familiar with have arisen in our country, where moreover the climatic conditions, subject to sharp variations between winter and summer and with elevation, impose severe requirements upon thermal and sealing properties. In the past five to seven years, some twenty prefabricated aluminum-glass facades have been erected for structures of major size, so that our metalworkers have gained some considerable experience with the problem.

On May 16, 1957, for the first time in Switzerland, we also witnessed the erection of prefabricated facade units for a ten-story office building in one day. In the matter of erection time, also, it would seem that our men are unwilling to be outdone by their colleagues in the U.S.A.

ALUMINUM APPLICATIONS IN ITALY

R. Donatelli

R. Donatelli received his architectural degree in 1950 from the Technical University of Milan. He is now a consulting engineer for Alluminio S.P.A. and Societa Generale Montecatini. Dr. Donatelli specializes in city planning and industrial installations. He has designed apartment houses, exhibitions, department store fixtures and furniture.

First of all, it must be said that aluminum, although a relatively new material in architecture, has reached such a height of development—due to the progress made in its fabrication and application—that it can be regarded as completely on a par with such conventional architectural materials as marble, steel, glass, wood, or brick.

In interior decorating, aluminum can be used for wall panels, ceiling panels, and furniture. The increased use of movable partition walls, e.g., in office buildings, has led to the development of standard units whose panels can be dimensioned in accordance with the room height and can be joined by means of simple fastening devices, thus facilitating the rearrangement of the walls according to need. The required characteristics of such partitions are lightness, durability and freedom from maintenance.

Panel frames should have a more or less complex shape to accommodate butts, blazing and trim. Extruded aluminum frames are particularly suitable for this requirement.

For certain buildings, especially public buildings, there is always the problem of curtain walls; these must be protected against wear, they should have few joints, and should have a genuine appearance. The lobby of the new administration building of the Montecatini Company in Milan, which was designed by architect Ponti, is well known to many. Its curtain walls are gold anodized extrusions, without horizontal joints. For large halls of this kind, extrusions of various shapes joined together offer a solution which has the advantages of "dry assembly," high precision, long life, and good appearance—all properties whose value I have already discussed.

In Italy, just like in other countries, this application becomes more and more frequent, since it is economical in competition with other building materials, and since the possibilities of coloring permits the designer to choose from among a variety of color tones. In elevators, aluminum extrusions have the additional mechanical function of forming the vertical walls, besides their decorative effect.

For ceilings, several methods of assembly using more or less aluminum have been developed. There are panel ceilings of perforated aluminum pans attached to a previously mounted screen; another method employs a grid of aluminum sections on which panels of aluminum or another material are placed. Here again the light weight and the permanence of the surface appearance are advantages which may have a determining influence on the designer in his choice of aluminum.

Several years ago I had the opportunity to design a ceiling for an exhibition using perforated aluminum pans, and the idea occurred to me to give the ceiling not only a functional but also a color-emphasized decorative effect. Most of the approximately 23½″ square aluminum sheets were supplied in white lacquer; I had some of these anodized in red, dark blue, gold, and light blue and positioned in an irregular fashion, but in keeping with a certain measure of color balance. In this way I believe I accomplished a panel ceiling with comprehensive design features, especially since aluminum air ducts could likewise be integrated into the ceiling.

I may add here that in my opinion installations are becoming increasingly important in modern building, firstly because the standard of living rises as communities become larger, and secondly because the individual quest for comfort is becoming greater. This undoubtedly creates possibilities for the use of aluminum which have not as yet been fully utilized; to take advantage of these potentialities will primarily be the task of our specialists.

Here again it must be said that careful utilization of the material properties will bring good results both from a functional and aesthetic point of view.

Let us now speak about some of the completed buildings which illustrate particularly well how we build with aluminum in Italy:

Railroad Terminal in Rome

In completing the design of this terminal the problem arose of how to create a fascia at the cantilevered roof of the large reception hall which is a characteristic feature of the well known building. Several building materials were considered, until finally aluminum was chosen not alone for its specific properties, which we need not mention again, but also in order to obtain an architectural harmony, since many other parts in the interior are of aluminum.

This fascia made of reinforced concrete is 427 ft. long and 8.2 ft. high; its cladding is an abstract relief featuring a repetition of geometrically irregular configurations obtained by superimposing aluminum sheets of various contours. The sheets are arranged in five planes kept apart at a distance of about 0.39-inch by means of spacers to avoid condensation damage which may occur as a result of air circulation through the spaces between sheets. Alloy used for 1/10″ thick anodized sheets was Anticorodal (AlMgSi).

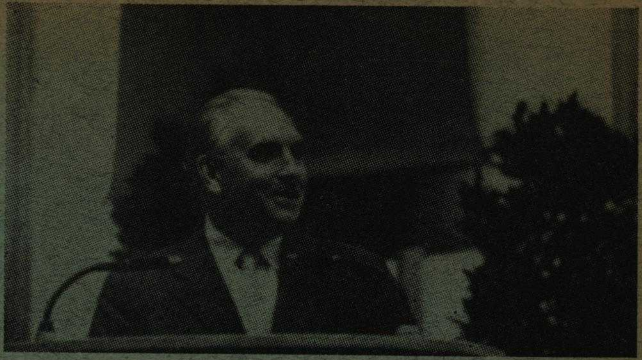
Thus, with a modern concept, modern tools and modern material, the assignment was given to create a modern fascia. While I do not wish to be a judge on the intrinsic value of this object as a work of art, I do appreciate its originality at a time when creative art endeavors to express a world in which technology clearly is the decisive element.

In the Olympic Stadium in Rome

The most striking building unit is the covered grandstand with its aluminum-clad steel structure. This grandstand houses forty offices for the administration, radio and television transmitters, time-keepers and photographers. The projecting roof shelters the front rows of the newspaper reporters. The vertical curtain walls are made from Anticorodal extrusions (AlMgSi); roof, partition walls, staircases, railings, etc., are likewise aluminum. There is no denying that this resplendent metal structure is an impressive sight on the periphery of the wide ellipse of the stadium.

In conclusion, I think we should also mention the administration building of the Olivetti Company in Milan for its decorative effect which was accomplished exclusively with the aid of functional building materials. These are the sun control louvers on the south side consisting of four different wedge-shaped extrusions with saw-tooth edges for appearance and to avoid glare; the light green tint of the anodized surface adds to this effect. Five louvers may be moved at a time by means of a crank. The various positions of the louvers give the facade a lively appearance.

Having mentioned these typical examples, I am taking the liberty of expressing my own view on decorative effects. While I do not want to adopt Adolf Loos' drastic remark that "decoration is a crime," I would still express the hope that the development of aluminum applications will be accompanied by refinements and that purely decorative applications will more and more give way to functional applications which take full advantage of the properties of the material. In this way aluminum's potential applications, as well as good architecture, will be enhanced.



ALUMINUM IN CONTEMPORARY GERMAN ARCHITECTURE

H. Hentrich

H. Hentrich, architect, BDA, studied at the universities of Freiberg, Vienna and Berlin, receiving his doctorate in Engineering at Vienna. He has traveled throughout the world and in 1929 received the famed Schinkel Prize.

If we were to leaf idly through the post-war volumes of architectural journals of various countries, we should be struck by the fact that an utter transformation has taken place in the style of facades compared to the period between the two wars. Whereas before the First World War, barring a very few exceptions (Gropius, Fagus works, 1914 Werkbund exposition), the facade displayed the supporting masonry, between the two wars the idea arose of opposing something new and different in architecture to the monumental. As early as 1923, there are designs by Mies van der Rohe in which the outside surfaces of projected tall buildings at the Friedrich-Strasse terminal in Berlin (prize competition) are largely resolved in glass. This development was encouraged by the building of skyscrapers. The tendency to eliminate heavy supporting walls from the facade and replace them by columns naturally led to a construction of the wall panels that was as light as possible.

The external, non-supporting facade now had no function to perform but protection against the elements, so that it could be made lighter still. The cantilevered floor was surmounted by a matching parapet, usually solid, and the connection to the floor above was made with windows. To get as much light as possible, the attempt was to build these wall panels thinner and more open. Metal offered itself as the obvious material for the purpose. Among the eligible metals, especially after the war, aluminum made great strides. Steel being quite subject to corrosion, and stainless steel and bronze usually prohibitive in cost, aluminum became the ideal solution once the problem of minor corrosion had been eliminated by anodic oxidation.

In discussing the question of using aluminum, the client is quite often heard to ask for examples demonstrating the great durability claimed for the metal. Mention having been made in previous papers of the success of aluminum roofing, it may be of help to cite an impressive example in the writer's home town, applicable to not a few other situations. I am speaking of the Rheinbahn pavillion in Dusseldorf, erected twenty years ago, where anodized aluminum sheets and sections were used extensively as a decorative element. The aluminum parts, as some pictures will show, are still in thoroughly satisfactory condition. In this connection it is interesting to note the guiding observations and considerations concerning the recently completed administration building of the Badische Anilinund Soda-Fabrik at Ludwigshafen, which was fitted with aluminum windows.

The choice of material for the outside windows of the main structure was preceded, because of exceptionally severe atmospheric conditions, by a weathering test of aluminum sections compared to other materials. The specimens were suspended at a distance of 400-600 m. from acid stacks. The test period was one-half to one year. The specimens were commercial window and door sections of various alloys and finishes as follows:

Surface Finish	Aluminum Alloys
a) Anodic Oxidation (Eloxal, 15-micron film)	A2 Mn AlMg 3 Mg Si
b) Plain as fabricated)	
c) Metal bonding primer)	
d) Zapon varnish)	
e) Wash primer, synthetic resin coating)	

None of these exposed specimens was greased or given any attention. The weathering tests showed that:
Of all the finishes used, only Eloxal remained intact;
Eloxal films lasted equally well on the different alloys;
Varnish coatings failed to afford adequate protection; in all cases

the coatings showed pores and the underlying metal became pitted;

All the aluminum alloys tested in plain condition as fabricated showed pronounced area corrosion.

Concurrent weathering tests of steel windows, and general experience in the chemical industries, indicated that the following surface treatment is required for steel:

a) Spray galvanizing of chemically clean bar steel;

b) One priming coat of oil-lead cyanamide;

c) One priming coat of Akydal red lead;

d) Two cover coats of Vinoflex alkyd resin combination enamel.

If two priming and two cover coats are used, galvanizing can be dispensed with, but protection is much improved by spray or dip galvanizing.

Experience shows that owing to intensive corrosion, especially in industrial areas, complete repainting is necessary after five years for ungalvanized steel windows and after fifteen years for galvanized steel windows; that is, all windows must be given two priming and one finish coat. For proper appearance, however, the two cover coats will need overhauling every two years.

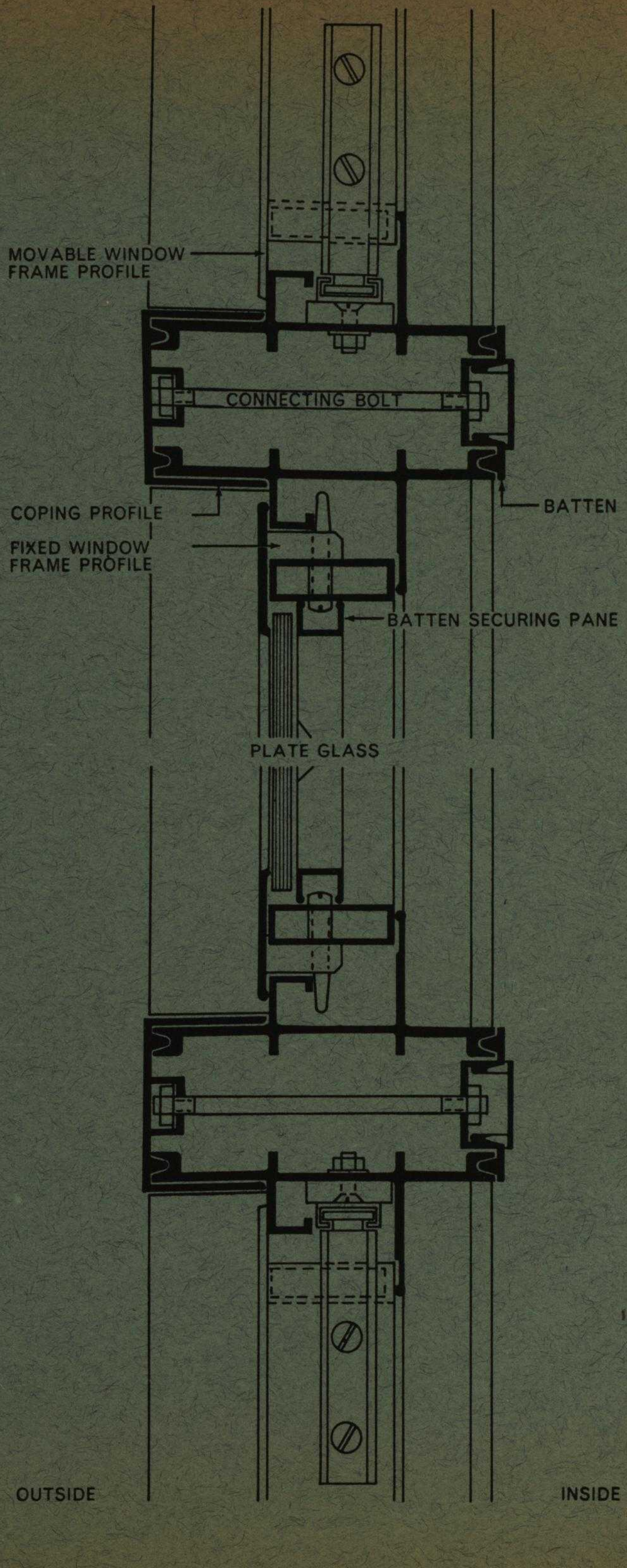
Annual maintenance costs for corrosion protection of steel run about 5% of initial cost of a steel window including surface treatment.

Inquiries of reputable firms indicated that window installations of A2 Mg 3 or A2 Mg Si with Eloxal film 18-20 microns thick were only 2% more expensive than steel windows with spray galvanizing and two prining and two cover coats.

Considering the practically unlimited forming possibilities of light metal profiles by the extrusion process, the resulting sections being not only decorative but efficient structural members, the decision in favor of all-light-metal construction is mandatory.

Still another fact should not go unnoticed. As in the United States, so in Europe, the trend is towards ever higher labor cost; manual maintenance of large structures will therefore occasion rising costs in the future. Such factors should always receive consideration in estimates of comparative economy.

The biggest problem is the mobility of such a metal-glass front under the influence of temperature, which must be unimpeded. This requires special care in the design of the sections. The metal-glass envelope should be designed as smooth and free from projections as possible to avoid deposition of dirt and to exclude the destructive effects of wind and weather, moisture and chemical



This window detail of The Hertie Department Store's Administration Building designed by Hamburg architect Hans Soll for West Berlin, Germany, is a first-rate example of modern German precision and style.

action of the atmosphere. Even if this is done, sufficient opportunities are open to architectural ingenuity to avoid the danger of monotony. The conformation of the parapets is especially challenging. Parapet panels can be admirably formed in aluminum to prevent warping of the sheets. Parapet elements can be made in any type of glass, with unlimited color possibilities. The use of aluminum foil of various thicknesses between two sheets of glass joined "thermopane" fashion will give a wealth of architectural effects. The "honeycomb aluminum" manufactured in the United States, and this year in Germany under license, can be used to great advantage with excellent insulating effect. The outer sheet can be done in mirror glass of various colors. Light tones of gray or blue harmonize very well with the natural color of aluminum. It has recently become possible to make such components from synthetics, and the Holoplast material made in England has been most successful. This material has the advantage over glass of greater lightness combined with better insulating effect. Of course, the selection of colors and textures as yet leaves something to be desired. It should be adapted to the particular requirements of facade design. The possibilities of artistic variation are practically unlimited. Much effort has been devoted to giving aluminum the appearance of other metals, especially bronzes and brasses of various kinds, by color anodizing. Technical success has been complete, but artistically unsatisfactory.

The trend of glazing a facade as completely as possible for maximum depth illumination has encountered the inevitable difficulties due to outside temperature influences; while protection against cold is a comparatively simple matter, the difficulty of heating due to solar radiation is serious. In countries with a warm climate, the dangers of overheating of interiors are of course greater. Many different expedients have been tried to control the sun's rays. Aluminum has been used with success for this purpose also. "Venetian blinds" have today conquered the whole world. Their use between two panes of double glass, however, entails the serious danger of overheating the window with resulting radiant effect. The same applies to installation of the blinds behind the windows. Some interesting experiments at the Stuttgart Polytechnic Institute have shown that the heating effect is about the same in the two cases. To diminish solar radiation into interiors, the use of Catacalor glass has been introduced in the United States, absorbing considerable solar heat, but at the expense of a permanent greenish coloration. Thermopane glass is to be produced in the United States shortly with a combination of green Catacalor with Rosalin panes. The combination of these colors cancels out the color effect, eliminating the undesirable tinge. However, this procedure reduces light intensity, of course also in dull weather. It could consequently be desirable to provide enough circulation for natural cooling of a sunshade installation. On an aluminum facade in Paris, the interesting experiment has been made of providing vertically sliding aluminum shutters for sun protection. There is much to be said for this idea, especially when sealed windows are used. The system is not oversensitive to wind, and cleaning is fairly simple. The Gartner firm in Germany has developed another type of sun protection in which the blinds normally placed on the inside can be rotated outward 180° with casements, thus stopping solar heat on the outside. This is a good idea, but it remains to prove its worth in construction of tall buildings where a permanent updraft and exposure to high winds must be reckoned with. In southern countries, attempts have been made to solve the problem by means of so-called "sundividers" (bris de soleil). The disadvantage of course is that even in retracted conditions, there is necessarily a considerable loss of light. Aluminum has proved an excellent material for sun dividers also. In conjunction with facade design, outstanding architectural effects can be achieved.

Attempts to provide adequate protection against solar radiation in large glass facades are of recent date. Even though results to date have been fairly satisfactory, the possibilities can by no means have been exhausted. Aluminum as a structural material has much to offer in this connection.

Another avenue of progress in construction leads to standardization of prefabricated facade units. When such units complete with solar protection means appear on the market, major sales opportunities will result. The unit heretofore used chiefly for skyscrapers may serve equally well for structures of only a few stories. The danger of monotony is slight, given judicious use, for the choice of an element leaves so many alternatives open in the structure as a whole that only an agreeable casualness can result. Excellent opportunities also exist in the fabrication of one-story buildings. Experiments have been made in this area, but only beginnings. A far-seeing industry will not fail to improve these opportunities.

In closing, I may mention two buildings now under construction in Dusseldorf, namely the administration buildings of the Mannesmann A.G. and the Phoenix-Rheinrohr A.G. The Mannesmannhaus, architect Schneeider-Esleben, Dusseldorf, is to have supporting skeleton and windows in the facade of aluminum, with enameled sheet-steel siding elements. This distinguished skyscraper, to be completed in 1958, should strongly encourage the use of aluminum in tall structures.

The Phoenix-Rheinrohr building is to have an aluminum-glass envelope also. As a steel manufacturer, the company would have liked to execute it in stainless steel, but dropped the idea because of excessively high cost.

THE APPLICATION OF ALUMINUM TO ARCHITECTURAL ENGINEERING IN GREAT BRITAIN

A. F. Hare

A. F. Hare, Architect, F.R.I.B.A. specializes in research building on materials and new methods of construction. He is also an expert in the design of commercial and industrial buildings. From 1945-1949, Mr. Hare concentrated on prefabricated structures, particularly houses. He designed the government sponsored aluminum house and was a consulting architect for housing projects in Africa, Egypt, India and Israel besides his native country, England. From 1945 to the present, Hare has been consulting architect to Almin Limited and Hawksley S.M.D. Limited, specializing in the development and application of aluminum in building.

The use of aluminum in structural engineering and building construction has increased greatly during the past twelve years.

By 1948 one of the most rapidly growing uses of aluminum was extruded sections for roof structures, trusses and purlins. S.M.D. alone had covered over a million square feet of buildings with aluminum roof structures during that year.

The first problem in the structural use of aluminum is the cost of the material which, volume for volume, is about two and a half times that of steel. In order to overcome this disadvantage the engineer must apply accurate and skillful design using the minimum amount of material—not just good structural design but good structural design in aluminum.

He is greatly assisted by the versatility of the extrusion process and by the high corrosion resistance of aluminum because he can use sections exactly designed to meet the conditions of service, very thin sections that will not deteriorate under atmospheric attack. He is justified in taking great pains over design, and in using expensive fabrication techniques in order to save material. During the early years, in fact, the saving on material at the expense of fabrication was somewhat exaggerated, but simpler designs and lower fabrication costs followed with only a small increase in weight.

The second problem is that of the relatively low elastic modulus, which gives rise to excessive deflections and elastic instability. The most important difference between the design techniques for aluminum and for steel arises from the effect of this lower modulus of elasticity, because of its bearing upon problems of deflection and the design of compression members. A steel section, strong enough from the bending point of view, is usually within the limits of the deflection requirements. This is not always the case with aluminum members, particularly when the span-to-depth ratio is fairly high, and therefore it is much more important to check actual deflection of an aluminum member than of a steel member.

The elastic modulus has, of course, a very important effect upon the strength of compression members and for this reason the cross-section of an aluminum strut should be designed so that the member possesses greater flexural rigidity without using more materials. For these reasons a system of construction was originally evolved in which the compression members were double-channel sections battened together, giving an extremely stiff member for the amount of material used. This technique of double-battened channels was used for most roof structures in England over many years, including the three-bay hangar erected at London Airport in 1950.

This was recognized as an expensive method of fabrication but it achieved the minimum consumption of material. A later development—further exploiting the advantages of the extrusion process—was the use of simple bulb angles, lipped channels, etc. increasing the area of metal at the roots and thus giving reasonable torsional rigidity. The use of bulb angles also obviated the local failure of thin outstanding legs of members; obviously, if these are not correctly proportioned, the strength of the whole member is reduced to the stress at which they will fail.

In design of lightweight roofs, the effect of suction (which can be developed on structures subjected to wind pressure) is of greater importance than with traditional structures. The total weight of light structures and covering is often less than the lift which can develop and thus there may be a definite reversal of stress in members of the structure.

It was recognized that for buildings other than special-purpose structures, the advantages of aluminum could be more fully utilized on very large spans. Here, dead weight of the structure becomes a much greater proportion of the load to be carried, and therefore the light weight of aluminum begins to contribute a considerable saving in the amount of constructional material required. Also, erection costs on large span roofs would show a much greater percentage saving than in the case of small roofs. There was, however, the problem of jointing to be solved before really large spans could be considered.

The most expensive part of structural engineering, other than material costs, is joining the various members together. The assembly of the first aluminum buildings was done in aircraft factories and naturally used aircraft methods, including the use of tubular rivets of small diameter. This practice has much to commend it for mass assembly of light structures by unskilled labor, but with larger structures tubular riveting had serious limitations. The shortage of suitable and practicable equipment for closing rivets of the diameter required for large structures limited earlier application to spans up to 40 feet or so, except by resorting to bolted construction. This was not entirely desirable as the only readily available bolts were of steel, involving the need to avoid bi-metallic corrosion by sheradizing and wet assembly with zinc chromate paste.

The satisfactory adoption of aluminum roof structures for a number of buildings resulted from the possibility of condensation dripping from the roof framing members. Moisture dripping from steel may be contaminated with corrosion deposits and can easily stain or damage the goods or materials within the building. On the other hand, there is no likelihood of damage or staining from this effect with aluminum, since it is non-toxic and colorless. A number of successful applications included buildings where special standards of product cleanliness are required such as in bakeries, laundries, textile plants, etc. and also where a corrosive atmosphere is created by the processes.

Many of the specialized jobs where aluminum had no competitor consisted of adding to existing structures where the work had to be done without interrupting the operations within the building. In many cases, only the light weight and ease of handling of the aluminum framework made this possible.

The "Comet" flight hangar for the De Havilland Aircraft Co. Ltd. carried out by S. M. D. in collaboration with De Havilland's Consultant Architects, James M. Munro & Son, consisted of a building of clear span 200 ft. (217 ft. overall) and a length of 330 ft. The main structure consists of twelve flat-top aluminum portal frames at 30-ft. centers, spanning 217 ft. between pinned bases with a clear height of 45 ft. Spanning between the portal frames at 10-ft. centers are aluminum northlight trusses, each truss weighing approximately 175 lbs. The primary and secondary members of the frames consist of double bulb angles, each portal frame weighing approximately 6 tons, 7cwts.

With a span of this size the structural weight was only about one-seventh that of an equivalent steel structure. The main structure was erected by 18 men in 13 weeks using only two 5-ton hand operated cranes and practically no scaffolding.

Of the smaller span "all aluminum" aircraft hangars, probably the most interesting in realizing the characteristics of the material were the transportable hangars. These were designed to provide light portable units which could be erected quickly without prepared foundations and with little or no lifting equipment. They were constructed of a number of centrally hinged arches. Each half arch rib was composed of four standard units, with hinged sections at the end, connecting at the apex to a similar half arch rib.

A pair of adjacent half arch ribs are assembled on the ground complete with purlins and sheets, then raised, pivotting about about their base, and connected at the center to the opposite half arch unit.

Another unusual type was the Aircraft Nose Docks of 170-ft. span, designed to provide cover for aircraft maintenance, The sliding doors have a special section which fits around the aircraft fuselage to provide complete protection from adverse weather. They were designed to answer the requirement for buildings to be easily transported to sites (however remote) and erected rapidly without mechanical assistance or scaffolding.

A recent all-aluminum hangar was built by Hawkesly S.M.D. for the Ministry of Supply, to Ministry of Works' specification. It has a clear span of 200 ft. and unrestricted depth of 250 ft. and a clear height of 50 ft. The design and details of construction were based upon the "Report" of the Institution of Structural Engineers.

The main structure consisted of 8 portal frames at 35-ft. centers, supporting stayed channel purlins at 10-ft. centers, which carry the roof decking and glazing. The portals are framed using extruded bulb angles.

Apart from aircraft hangars, aluminum construction has been used for a variety of large span structures in Great Britain throughout the last seven years. One of the first was the "Dome of Discovery", the largest dome in the world and by far the largest single structure to be built in aluminum. It was built for the Festival of Britain 1951 to house the main exhibit. The architect was Ralph Tubbs, the consulting engineers, Freeman, Fox & Partners, and the aluminum fabrication was by S.M.D.

The structure had an overall diameter of 365 ft. and covered an area of 104,000 sq. ft; it was over one-fifth of a mile in circumference. The height from ground level to the center of the dome was 90 ft.

The designers adopted a composite construction, aluminum and steel, each being applied where their performance characteristics were most fully utilized.

The structure consisted of a steel ring girder 342 ft. in diameter supported on steel struts of lattice construction. This ring girder supported the whole of the dome structure, comprising arch ribs, rafters, purlins, roof sheeting and canopy, and was all of aluminum. In the system of construction used the main arch ribs were arranged as true great circles in three directions to form a triangulated structure. The main ribs and lattice girders of triangular cross-section curved to a radius of 365 ft. to follow a great circle course across the dome. In all, some 232 tons of aluminum were used.

The basic conception of design was to contrast the visual solidity of sweeping horizontal galleries within the building, constructed of reinforced concrete, massive and bold in character with the lightness of the vast aluminum saucer dome which spanned out and beyond all the galleries and which was supported on only 48 light tubular struts.

For efficient operation within many factories and warehouses the number of obstructions to freedom of movement must be kept to the minimum, internal columns are undesirable and in some cases impossible. On many projects the architect and engineer have the problem of deciding with the production engineers the relative values of a completely unobstructed floor space compared with the increased cost of the structure when large spans are used without any internal columns. With portal frame construction, using deep latticed columns similar to those of the various S.M.D. aircraft hangars, the strength-for-weight ratio of the structure in aluminum compared with steel is often similar to the difference in cost per ton of aluminum compared with steel. For factory buildings, however, using a simply supported truss on concrete or steel columns, the cost in England compared with steel is higher, although to some extent counteracted by the perpetual saving in maintenance costs plus the reduced trouble and obstruction that result.

One of the larger span jobs recently carried out by Hawkesley S.M.D. came within this category. This consisted of the roof structure for a warehouse 179 ft. long by 206 ft. wide. The 206 ft. span aluminum lattice trusses were carried on concrete columns, each truss was freely supported on a rocker shoe at one end and on a pin shoe at the other. The purlins, ties, braces, etc. were in aluminum. A complete aluminum truss weighed 6 tons and was delivered to the site in four sections and erected by mobile cranes. The consulting engineers for this warehouse were Frederick Snow & Partners.

A number of the roof structures are, of course, of orthodox design—that is orthodox so far as steel, the traditional material is concerned. What we require are more structures specifically designed for aluminum construction, obviously differing in conception from those structures using other materials.

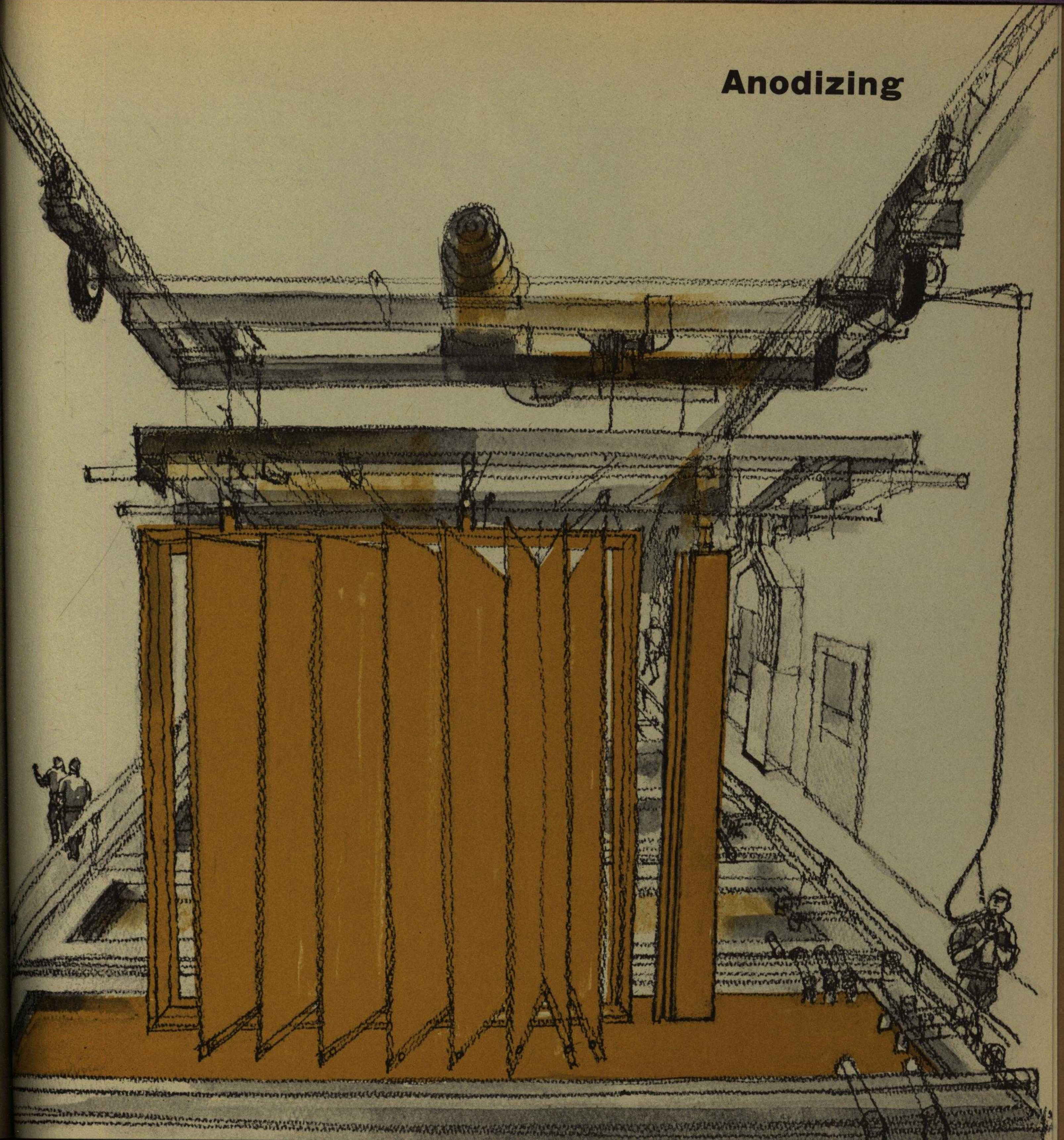
Some years ago Ove Arup & Partners, Consulting Engineers, designed a store building with an aluminum roof structure of only 42 ft. span, of which it was stated that the overall cost of the roof was competitive with that of other more orthodox forms. The structure consisted of a number of triangular aluminum space frames projecting above the general level of the roof, and the sloping sides were covered with aluminum glazing. Roof decking units spanned between adjacent space frames without any purlins or intermediate supports.

This provided not only an economical method of construction, but a means of giving uniform light over a very large area and with a pleasing interior soffite.

An endeavor has been made in this brief survey to illustrate the most salient features in the development of the use of aluminum in architectural engineering. Experience gained has provided a background of knowledge for present day applications, notably curtain walling.

The majority of this development has been carried out by the aluminum industry and associated companies, but it is now up to the designer to take advantage of this knowledge and experience and indicates the necessity for resourceful and imaginative design embodying the full characteristics of the material and improved production technique.

Anodizing



Few processes having to do with building materials are as advantageous and perhaps as little understood as anodizing. A brief explanation, accompanied by on-the-spot sketches, may help to familiarize architects and builders with this increasingly important aluminum finishing process.

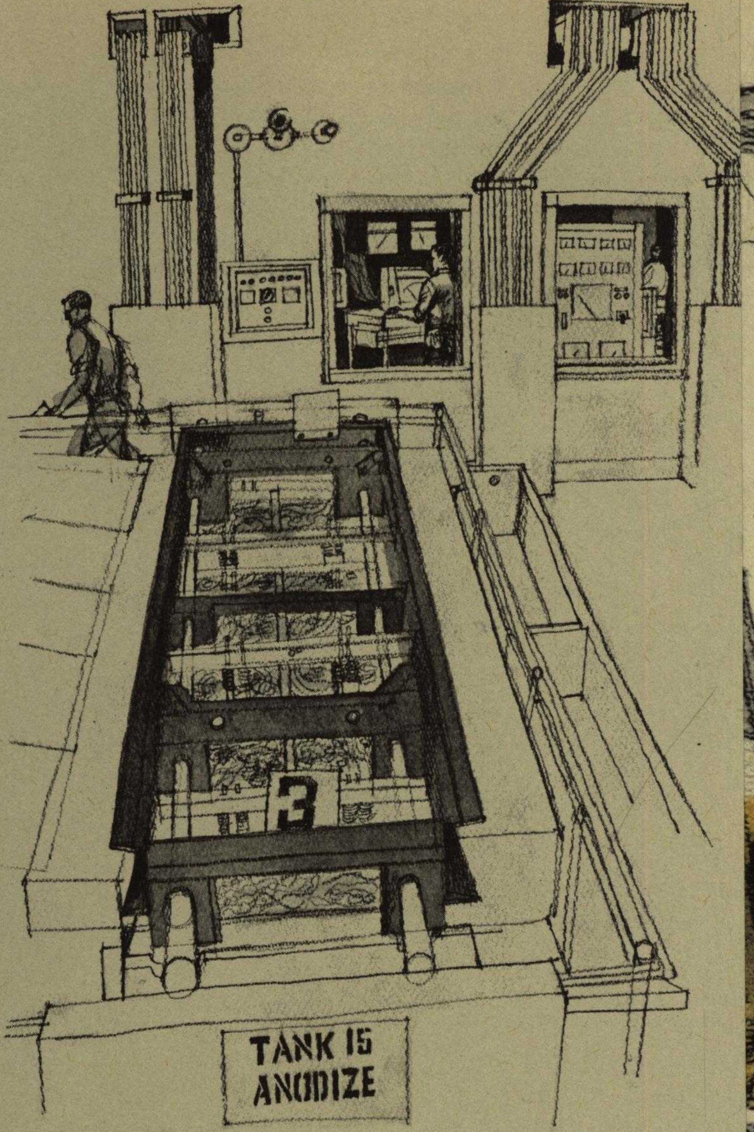
Aluminum possesses a remarkable affinity for oxygen, so that a thin, tenacious film of aluminum oxide is formed almost instantaneously upon its surface when exposed to the atmosphere. This film not only protects the metal from further oxidation but gives aluminum its natural ability to withstand weathering and corrosion.

For architectural applications where maximum resistance to weathering and corrosion is desired, along with full retention of the original attractive appearance of any mechanical or chemical surface finishing treatment that may have been applied, this natural oxide film can be increased in thickness and effectiveness many times over by an electrochemical process known as anodizing. The film may then be left clear or made to take a color. A subsequent sealing process closes its pores tightly.

The result is a uniform, hard, glass-like film that is not on top of the metal but an integral part of the metal surface itself. Its thickness will be from 0.0008 to 0.0010-inch, according to processing. Its appearance will vary from that of a clear, perfectly transparent coating to a dark, opaque, slate gray, depending on processing details and the aluminum alloy selected. This film not only offers great resistance to abrasion and corrosion but also provides amazingly effective protection against weathering.

As generally referred to in the building industry, the anodizing process is not a single operation but rather it is a group of related operations which offer a wide range of pleasing surface textures and colors . . . all with good abrasion and weather resistance.

The overall anodizing practice usually includes such operations as preliminary mechanical finishing, cleaning, etching, chemical brightening, anodizing, neutralizing, coloring, and sealing — all of which perform some independent function in producing the final appearance of the coating or its abrasion and weather resistant characteristics.



The anodizing tank is the heart of the process used for clear and color anodizing aluminum sheet and extrusions. The anodizing solution concentration, temperature, and electrical power input employed to develop the oxide coating must be carefully controlled to ensure uniform properties and thickness of the oxide film from piece to piece, and batch to batch. Current density, voltage, and temperature are automatically regulated by electronic units in the glass enclosed control room at the side of the anodizing system.

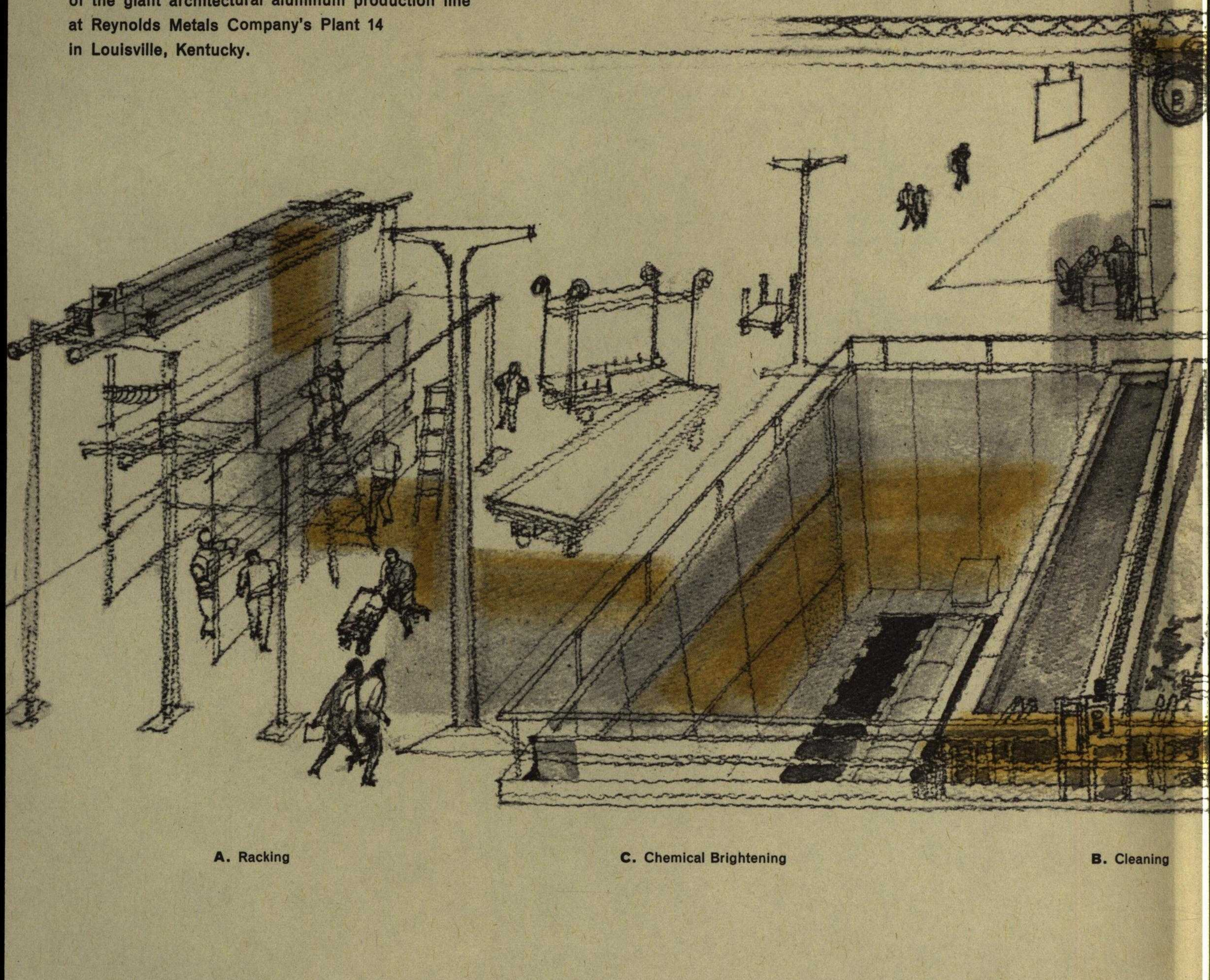
PRELIMINARY SURFACE TREATMENTS

Mechanical Finishing: The purpose of preliminary mechanical finishing, such as polishing, buffing, belt sanding, and sand blasting, is to develop uniform surfaces with a particular texture, reflectivity and specularity.

Since most of the aluminum alloys used in the architectural industry develop clear oxide films when anodized, the surface finishes applied mechanically are viewed through the oxide film as though looking through a window. These techniques permit

ANODIZING

from start to finish can be seen in this sketch of the giant architectural aluminum production line at Reynolds Metals Company's Plant 14 in Louisville, Kentucky.



A. Racking

C. Chemical Brightening

B. Cleaning

A. This is the beginning of a 350-foot anodizing line specially designed for finishing the large structural units demanded by today's architecture. This line is 27 feet wide and can hold 37 tanks . . . with 13,000 gallons in each tank. At extreme left, men are bolting unfinished panels to an aluminum frame to be picked up by the overhead crane and transported to the first tank. Bolting assures a firm contact to carry electric current to the panels. Each tank measures 5′ x 25′ x 14′ inside, enabling large monumental curtain-wall assemblies to be processed. **B.** The work usually goes first into a cleaning solution to remove any grease or dirt from the surface of the pieces. This solution is generally hot and mildly alkaline. Immersion in rinse baths follows each solution to avoid contamination of subsequent tanks. **C.** If the load is to be brightened, it goes to the tank containing a chemical brightening solution

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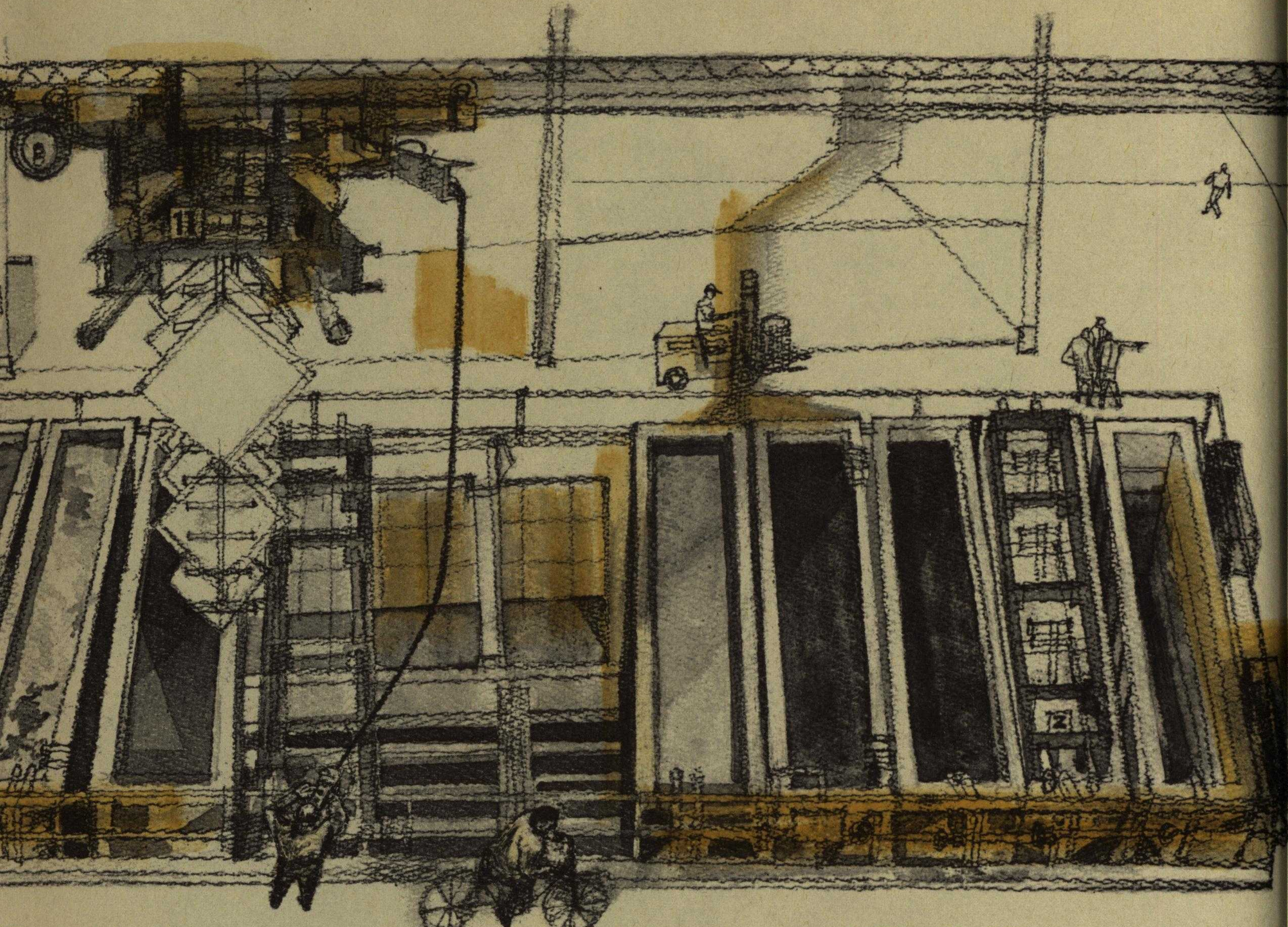

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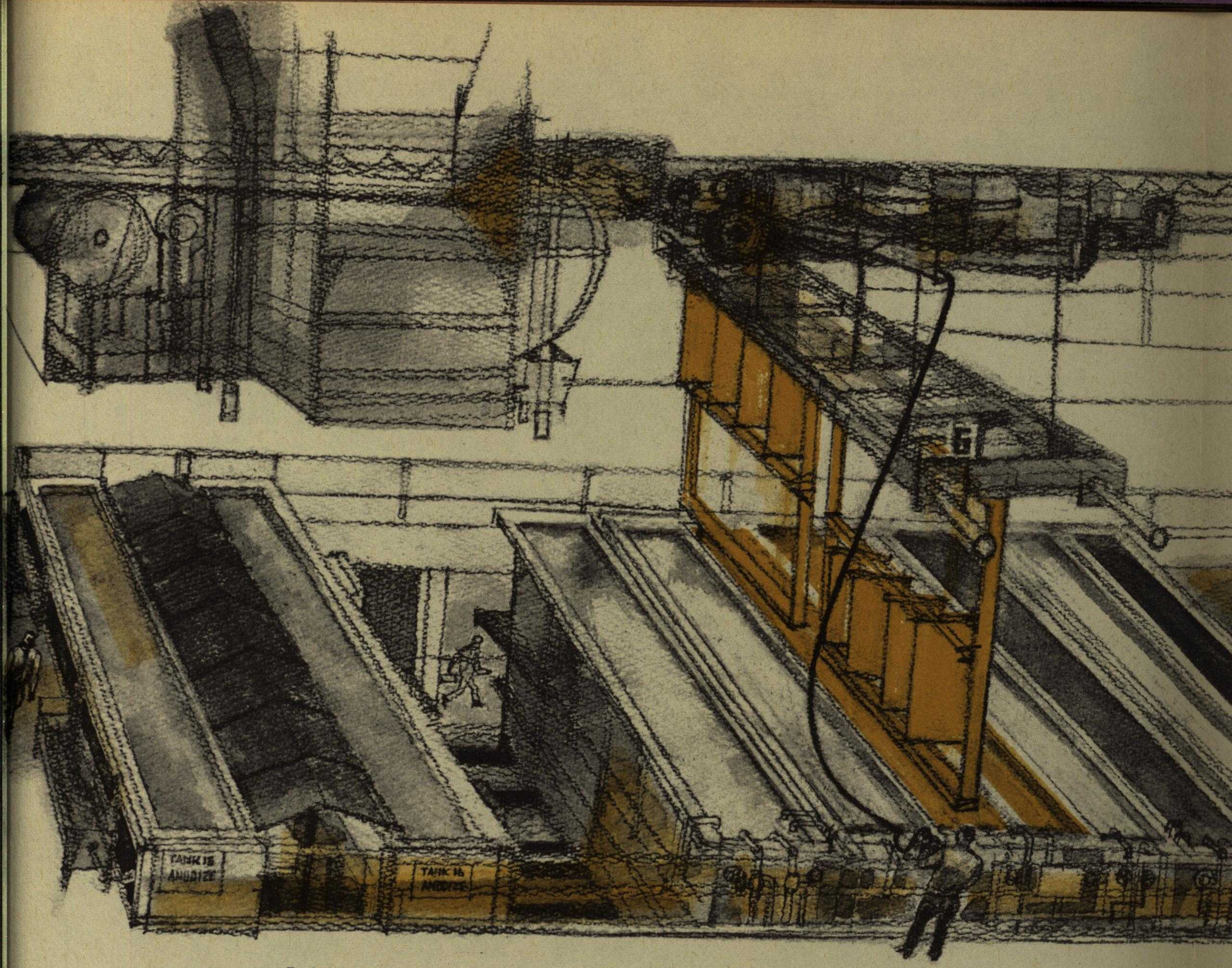
D. Etching and Desmutting

after cleaning. It next receives a thorough rinse. **D.** If an etched instead of a brightened finish is designated, a solution of caustic soda replaces bath C. After this etch, the piece must be immersed in the desmutting tank and then rinsed again in cold water. The work is now ready for the anodizing tank. **E.** The load is lowered into a 15-18% solution of sulfuric acid held at a temperature of 70° ± 1°F. Direct current at 15-20 volts passes from the aluminum pieces to the electrolyte for an average of 60 minutes. The resulting anodic film is highly resistant to corrosion and abrasion, possesses good absorptive qualities, is inert and heat resistant. **F.** After anodizing, the load is thoroughly rinsed. To assure the removal of excess sulfuric acid, the load is dipped in a neutralizing solution and again rinsed. **G.** Anodized pieces to be colored by dyeing are lowered immediately into the dye solution.



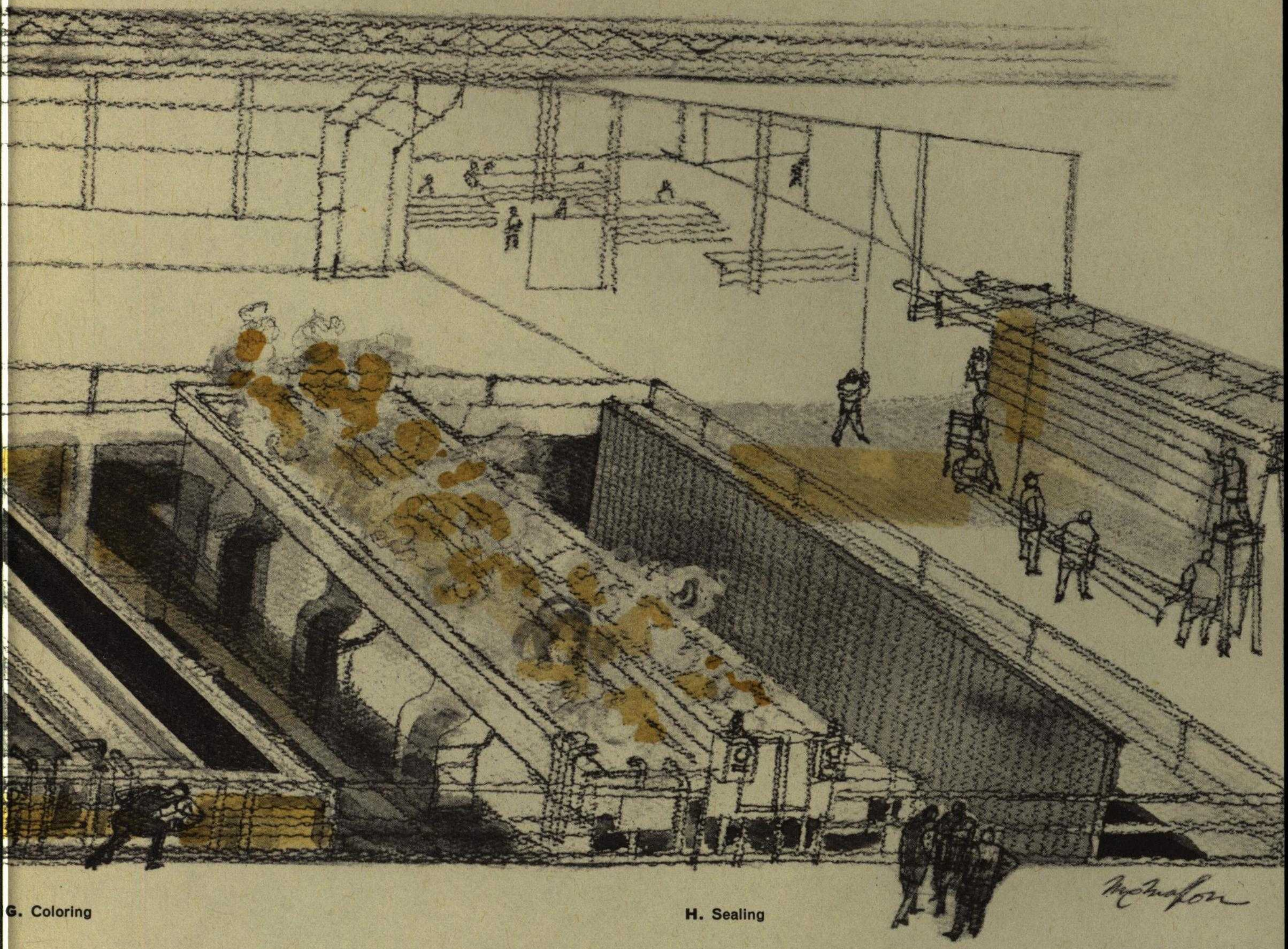
E. Anodizing

F. Neutralizing

G. Co

Temperature of the solution is closely controlled to ensure uniform coloring. Gold, blues, yellows and blacks are most suitable for exterior use as they are more stable in sunlight. Gray is obtained by anodizing silicon-containing alloys. These gray colors can be dyed to produce gray gold, gray blue, etc. When the desired color is believed to have been reached, the load is raised from the dye tank. The operator checks an approved sample against the work load to get an exact color match. It may be necessary for the load to be lowered once more into the tank briefly and once again checked before the proper color is adjudged to have been reached. This comparison is done with the human eye, as no mechanical means is sufficiently accurate.

H. After dyeing, the anodized surface remains porous. In order to fix the dye and seal the pores the load is lowered into a hot solution of acetates



G. Coloring

H. Sealing

of nickel or cobalt. If the anodized pieces have not been dyed, boiling water is sufficient to seal the pores. This treatment converts the oxide to the monohydrate form with a subsequent increase in volume which closes the pores and makes the film impermeable.

After sealing, the final step in the anodizing process, the load is lowered into the drying tank where huge fans rapidly dry the pieces. Then the work is moved to the unloading station for lacquering, packing and shipping. The items that started down the line with a soft, dull surface have emerged with a hard, tough, colorful and highly resistant film that makes aluminum today's most versatile architectural metal. While many variations in type of solution, current supply, processing time, and other factors are possible, the sulfuric acid process as described has been found best for architectural work.

striking effects in contrasting surface variations and themes to be incorporated into a building.

Chemical Finishes: Major preliminary chemical finishes are similar to mechanical finishes in that they also develop matte or bright surfaces. Etching, for example, produces a soft matte finish while chemical brightening gives a surface of high luster.

On the other hand, chemical finishes will not remove prior surface defects such as scratches and die lines, as will mechanical finishing techniques. Consequently, they are generally not recommended for the jewelry-like quality surfaces desired for store fronts, doors and other applications where close visual contact is common . . . unless preceded by mechanical finishing.

PROCESSING

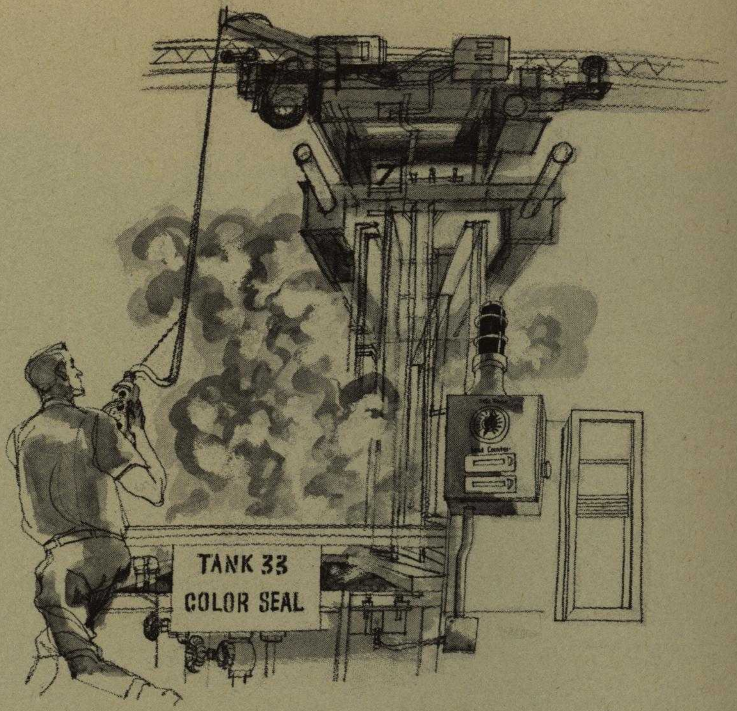
Procedures generally associated with anodizing are in sequence as follows: mechanical finishing, if required; racking; cleaning; chemical brightening or etching, as required; desmutting; anodizing; coloring, if required; sealing; drying; unracking. Parts to be processed are loaded onto special racks constructed of aluminum and titanium. Parts must be mounted securely to prevent movement and to ensure good electrical contact.

Cleaning: The first step in producing any chemical or electrochemical finish is to start with a chemically clean surface. All grease, oil and other surface contamination must be removed. This is accomplished in alkaline cleaning solutions which are so inhibited that they do not attack or modify the surface of the metal. After thorough cleaning, the parts are rinsed in water to prevent contamination of subsequent processing solutions.

Etching or Chemical Brightening comes next. Many different forms of etching solutions will produce soft matte finishes on aluminum. However, modified caustic soda solutions are the most economical and most popular. By controlling the concentration, temperature and time of etching, various degrees of chemical attack and resulting surface matteness can be produced.

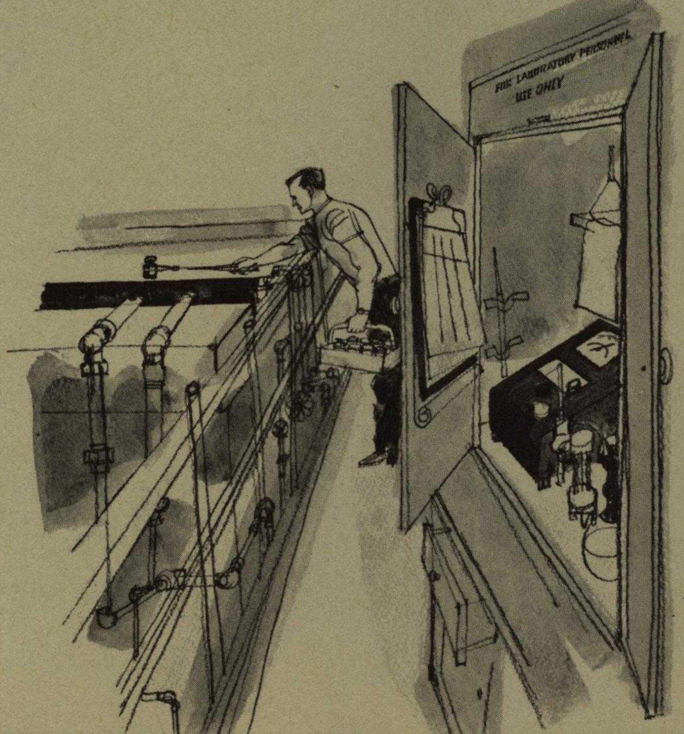
When bright surfaces are desired, the parts are chemically brightened in solutions containing various mixtures of hot acids which attack projections, thus leveling the surface and producing a smoother and more lustrous appearance.

Desmutting: Next the parts are thoroughly rinsed in water and immersed in an acid solution which will remove the black smut developed from etching and the heavy metals, such as copper, which may be left on chemically brightened parts.



The coloring media used for producing color anodized parts must be sealed into the coating. The work is transported from each of the various stages of anodizing by overhead cranes.

Concentration and pH of all processing solutions must be controlled by frequent, on-the-spot analyses to ensure maximum surface uniformity, color and quality of the anodic film.



Anodizing: Aluminum can be anodized in many different types of solutions since the purpose of the electrolyte is to act as an oxidizing agent. However, the overwhelming majority of architectural parts are anodized in sulfuric acid baths.

Passing an electric current from the work through the electrolyte to the cathode causes oxygen to be evolved at the surface of the aluminum. The thin natural film of oxide on the aluminum allows current to flow and permits the oxygen to react with the underlying aluminum to form additional oxide, thus increasing the thickness of the original oxide film. Since the film formed is porous (until sealed, as explained below), this action continues as long as current is applied and new oxide film forms underneath the older, increasing the total film thickness.

The properties of the oxide coating developed by anodizing in sulfuric acid (corrosion and abrasion resistance, and the ability to absorb coloring dyes) depend upon the concentration and temperature of the sulfuric acid solution, the electric current and the length of time it is applied. Thick, dense coatings provide the maximum protection. Consequently, for most architectural applications, particularly those which receive considerable abrasion, or are infrequently cleaned, an anodizing time of 60 minutes is generally specified, along with an applied potential of 15-20 volts, producing a current density of 12 amperes D.C. per square foot and developing a minimum oxide film thickness of 0.0008-inch. The concentration of the sulfuric acid solution is maintained reasonably constant between 15 and 18 percent and the bath temperature held at 70°F ± 1°F.

Next, the parts must be thoroughly rinsed in cold water and preferably neutralized in a very weak alkaline solution such as sodium or ammonium bicarbonate. If the anodizing solution is not removed completely, it will contaminate the coloring solution and locally interfere with coloring and sealing.

Coloring: As previously explained, oxide coatings are porous and consequently will absorb dyestuffs and forms of inorganic coloring media. This creates a brilliant and unique coloring with the luster of the metal shining through the color-impregnated oxide to greatly extend the pallet of the architect.

The light stability of color anodized aluminum depends on the stability of the coloring media, its concentration within the coating, and its penetration through the full depth of the coating. Consequently, a 0.0008-inch film is desirable for color stability as well as corrosion and abrasion resistance. After anodizing, the work is dipped in the proper concentration of an organic dye bath maintained at about 140° F for coloring.

As with all dyed material, whether cloth or anodic film, certain colors may be safely specified only for interior use. Basic colors suitable for exterior applications are: blue, yellow, black, and gold. This color range can be greatly extended by the use of certain aluminum alloys, since the alloy also affects the color of the anodic film. For example, Reynolds RF-40 produces a slate-gray anodic coating when anodized. The basic blue die then produces a blue-gray colored film, yellow becomes avocado, gold — shades of bronze and brown. The slate-gray color obtained on this alloy without dyeing has excellent light stability in itself, because the color comes from the silicon particles which remain unchanged by the processing.

Other alloy constituents will also oxidize and color the film. Thus chromium in the alloy produces a yellowish tint; manganese gives a brown, opaque appearance. A third coloring method employs solutions which react with each other to form insoluble colored compounds. For example, lead acetate treated with potassium dichromate yields a yellow colored film. Potassium ferrocyanide treated with ferric chloride gives a blue. Colored oxide films can also be produced directly in the anodizing bath by acid combinations and addition agents. For example, sodium borate used with sulfuric acid produces a silvery oxide film. Some of these processes are not yet regarded as commercial.

Mechanical and chemical preliminary treatments produce great contrasts in color shade just as they produce contrasts in the appearance of clear anodized aluminum. Thus they extend the possible range of colors and shading still further.

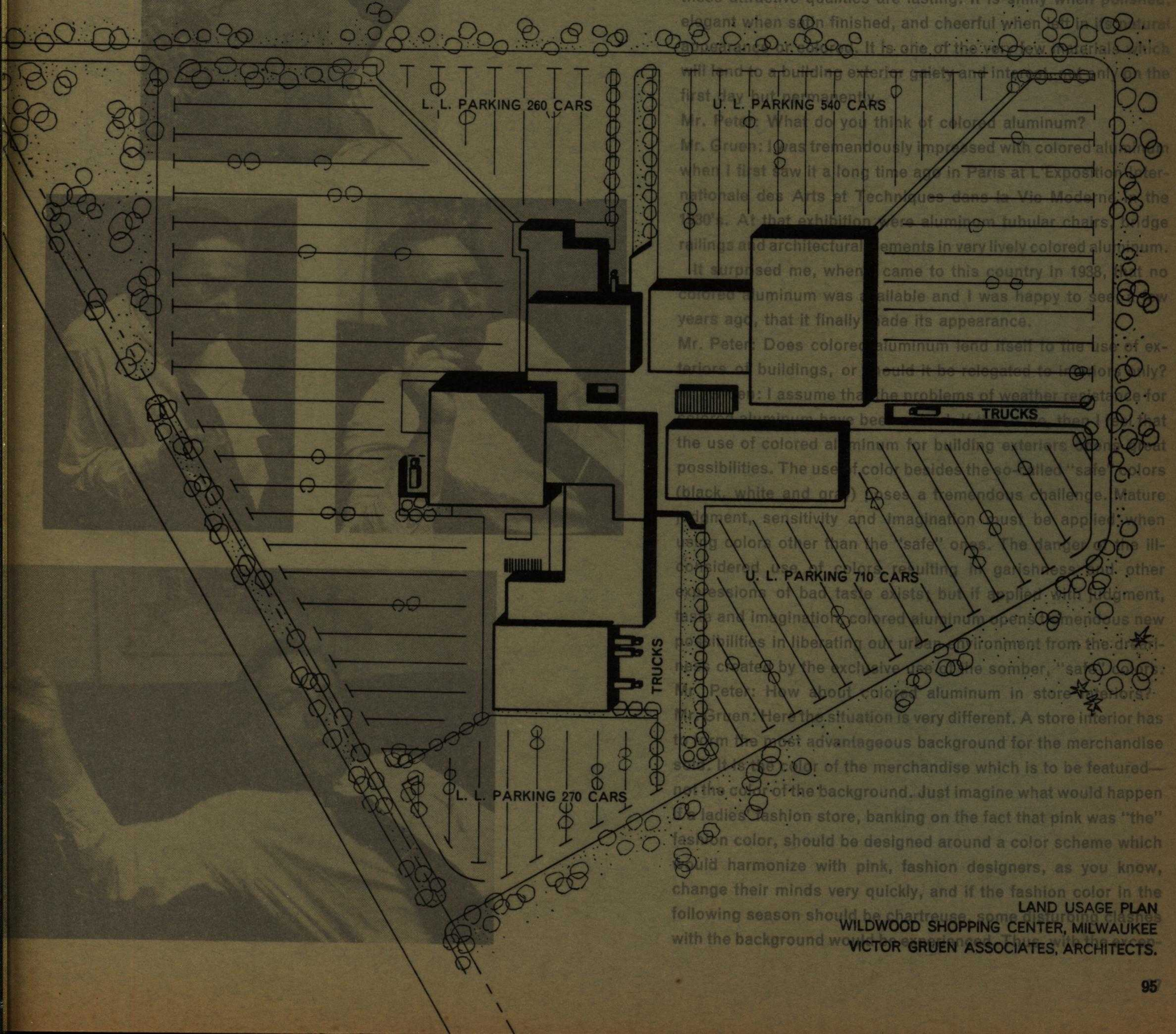
Sealing: After coloring, the parts are rinsed in cold water and then the pores are sealed. Sealing is accomplished on non-colored parts by immersion for specified periods of time in boiling distilled or deionized water. The oxide lining of the pore wall is converted to the monohydrate form with a subsequent increase in volume. This closes the pores and makes the anodic film impermeable and resistant to staining as well as more corrosion resistant. Colored work is first sealed in hot solutions of nickel or cobaltous acetates which hold the dye in the film and prevent leaching by the final sealing operation done in boiling water.

Most anodized architectural parts are also given two coats of a special clear lacquer baked on to protect the surface from alkaline materials such as mortar and plaster, and to provide additional protection during handling and erection.

Aluminum, electricity, and chemistry — the three elements of anodizing — are all relatively recent developments of man's continuing long search for better things. Clearly we are only beginning to appreciate the uses of this light-weight building material and the electro-chemical methods of enhancing it. This bright beginning already offers exceptional advantages and promises even more for the future.

The Future of Aluminum in Modern Architecture

The best way to learn about the future of architecture is to talk to the men who will create it. Here are informal tape-recorded conversations with three architects and one architectural engineer. Renowned for the quality of their work as well as the influence of their imagination, they discuss with conviction both architecture and aluminum.



LAND USAGE PLAN
WILDWOOD SHOPPING CENTER, MILWAUKEE
VICTOR GRUEN ASSOCIATES, ARCHITECTS.

Anodizing: Aluminum can be anodized in many different types of [illegible] of [illegible] act as an oxidizing agent. However, the overwhelming majority of architectural parts are anodized in sulfuric acid baths.

Passing an electric current from the work through the electrolyte to the cathode causes oxygen to be evolved at the surface of [illegible]. The [illegible] oxide [illegible] allows current to flow and permits the oxygen to react with the underlying aluminum to form additional oxide, thus increasing the thickness of the original oxide film. Since the film formed is porous (until sealed, as explained below), this action continues as long as current is applied and new oxide film forms underneath the older, increasing the total film thickness.

The properties of the oxide coating developed by anodizing in sulfuric acid (corrosion and abrasion resistance, and the ability to absorb coloring dyes) depend upon the concentration and temperature of the sulfuric acid solution, the electric current and the length of time it is applied. Thick, dense coatings provide the maximum protection. Consequently, [illegible] architectural applications, particularly those which receive considerable abrasion, or are infrequently cleaned, an anodizing time of 60 [illegible] generally specified, along with an applied potential of 15-20 volts, producing a current density of 12 amperes D.C. per square foot and developing a minimum oxide film thickness of 0.0008-inch. The concentration of the sulfuric acid solution is maintained reasonably constant between 15 and 18 percent and the bath temperature held at 70°F ± 1°F.

Next, the parts must be thoroughly rinsed in cold water and preferably neutralized in a very weak alkaline solution such as sodium or ammonium bicarbonate. If the anodizing solution is not removed completely, it will contaminate the coloring solution and locally interfere with coloring and sealing.

Coloring: As previously explained, oxide coatings are porous and consequently will absorb dyestuffs and forms of inorganic coloring media. This creates a brilliant and unique coloring with the luster of the metal shining through the color-impregnated oxide to greatly extend the pallet of the architect.

The light stability of color anodized aluminum depends on the stability of the coloring media, its concentration within the coating, and its penetration through the full depth of the coating. Consequently, a 0.0008-inch film is desirable for color stability as well as corrosion and abrasion resistance. After anodizing, the work is dipped in the proper concentration of an organic dye bath maintained at about 140° F for coloring.

As with all dyed material, whether cloth or anodic film, certain [illegible] exterior use. Basic colors suitable for exterior applications are: blue, yellow, black and gold. This color range can be greatly extended by the use of certain aluminum alloys, since the alloy also affects the color of the anodic film. For example, Reynolds RF-40 produces a slate-gray anodic coating when anodized. The basic blue die then produces a blue-gray colored film, yellow becomes avocado, gold — shades of [illegible]. The slate gray color obtained on the alloy [illegible] the color comes from the silicon particles which remain unchanged by the processing.

Other alloy constituents will also oxidize and color the film. Thus chromium in the alloy produces a yellowish tint; manganese gives a brown, opaque appearance. A third coloring method employs solutions which react with each other to form insoluble colored compounds. For example, lead acetate treated with potassium dichromate yields a yellow colored film. Potassium ferrocyanide treated with ferric chloride gives a blue. Colored oxide films can also be produced directly in the anodizing bath by acid combinations and addition agents. For example, sodium borate used with sulfuric acid produces a silvery oxide film. Some of these processes are not yet regarded as commercial.

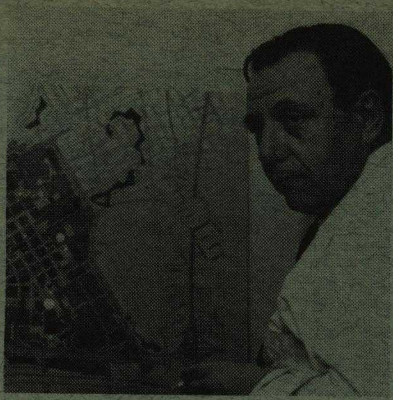
Mechanical and chemical preliminary treatments produce great contrasts in color shade just as they produce contrasts in the appearance of clear anodized aluminum. Thus they extend the possible range of colors and shading still further.

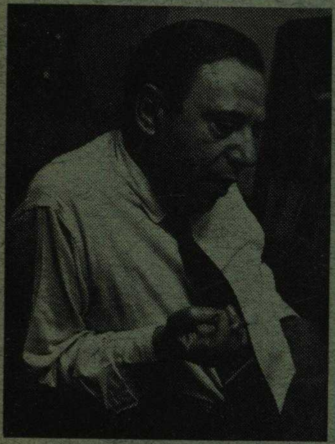
Sealing: After coloring, the parts are rinsed in cold water and then the pores are sealed. Sealing is accomplished on non-colored parts by immersion for specified periods of time in boiling distilled or deionized water. The oxide lining of the pore wall is converted to the monohydrate form with a subsequent increase in volume. This closes the pores and makes the anodic film impermeable and resistant to staining as well as more corrosion resistant. Colored work is first sealed in hot solutions of nickel or cobaltous acetates which hold the dye in the film and prevent leaching by the final sealing operation done in boiling water.

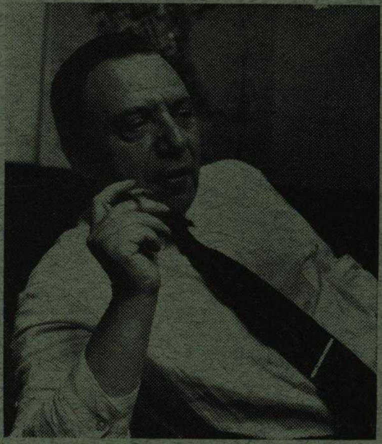
Most anodized architectural parts are also given two coats of a special clear lacquer baked on to protect the surface from alkaline materials such as mortar and plaster, and to provide additional protection during handling and erection.

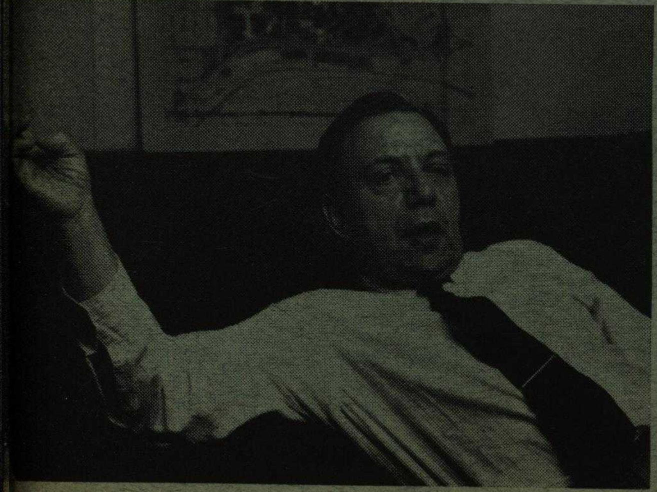
Aluminum, electricity, and chemistry — the three elements of anodizing — are all relatively recent developments of man's continuing long search for better things. Clearly we are only beginning to appreciate the uses of this light-weight building material and the electro-chemical methods of enhancing it. This bright beginning already offers exceptional advantages and promises even more for the future.

Victor Gruen An architect famed for shopping centers and city plans









Mr. Peter: Does aluminum have a place in modern architecture?

Mr. Gruen: Definitely! Aluminum has a highly advantageous place in modern architecture. It appears where you can see it, where it meets the eye of the public . . . on the outside, on the skin of the building, and on its roof. No material could have a more advantageous place.

Mr. Peter: Do you think it has an attractive appearance?

Mr. Gruen: It has many attractive qualities and, what is important, these attractive qualities are lasting. It is shiny when polished, elegant when satin finished, and cheerful when left in its natural appearance or colored. It is one of the very few materials which will lend to a building exterior gaiety and interest, not only on the first day but permanently.

Mr. Peter: What do you think of colored aluminum?

Mr. Gruen: I was tremendously impressed with colored aluminum when I first saw it a long time ago in Paris at L'Exposition Internationale des Arts et Techniques dans la Vie Moderne in the 1930's. At that exhibition were aluminum tubular chairs, bridge railings and architectural elements in very lively colored aluminum.

It surprised me, when I came to this country in 1938, that no colored aluminum was available and I was happy to see, a few years ago, that it finally made its appearance.

Mr. Peter: Does colored aluminum lend itself to the use of exteriors of buildings, or should it be relegated to interiors only?

Mr. Gruen: I assume that the problems of weather resistance for colored aluminum have been solved. If that is so, then I feel that the use of colored aluminum for building exteriors opens great possibilities. The use of color besides the so-called "safe" colors (black, white and gray) poses a tremendous challenge. Mature judgment, sensitivity and imagination must be applied when using colors other than the "safe" ones. The danger of the ill-considered use of colors resulting in garishness and other expressions of bad taste exists; but if applied with judgment, taste and imagination, colored aluminum opens tremendous new possibilities in liberating our urban environment from the dreariness created by the exclusive use of the somber, "safe" colors.

Mr. Peter: How about colored aluminum in store interiors?

Mr. Gruen: Here the situation is very different. A store interior has to form the most advantageous background for the merchandise sold. It is the color of the merchandise which is to be featured—not the color of the background. Just imagine what would happen if a ladies' fashion store, banking on the fact that pink was "the" fashion color, should be designed around a color scheme which would harmonize with pink, fashion designers, as you know, change their minds very quickly, and if the fashion color in the following season should be chartreuse, some disturbing clashes with the background would be experienced. Thus, with the exception of those retail establishments which sell merchandise which is characteristically neutral as far as colors are concerned (like a hardware store, for example), the coloring of the store interior must be discreet and colors of intensity might be used only with great discretion and in small, defined areas.

Mr. Peter: Do you believe that the "All-glass facade" in which aluminum plays such an important role is here to stay?

Mr. Gruen: No. The building as a glass box is, in my opinion, a temporary phenomenon. At present we are romanticizing a newly won freedom of expression which modern technology has given us. The fact that we are now technically able to heat and cool a building even if all its walls consist of glass is, of course, quite an achievement. However, it is also a fact that we do so only by making all kinds of sacrifices. People living or working in glass houses suffer from the heat created by direct sun rays, from glare, and from loss of useful wall areas. When the heat and glare problem is partly ameliorated by the tinting of glass, the view which one attains when looking out from the glass house also becomes colored and loses its naturalness. The appearance of tremendous glass boxes seems quite stunning to us right now. This is partly due to novelty and partly to "reflected glory." The interest of a glass facade of a twentieth century building is often derived from the interesting reflections of some nineteenth century building appearing on it. Glass enclosed office buildings are supposed to open to the office workers a cheerful view of the surroundings; but inasmuch as the surroundings are usually not very cheerful, and because of the sun and glare problems mentioned before, we usually find when observing these glass office buildings, that all Venetian blinds or curtains are tightly drawn. A glass front seems to have greater justification if it is desirable not just to look out but also to look into the building. In this respect, the Manufacturers Trust Company by Skidmore, Owings & Merrill seems to me to have full design justification. Here, a great promotional value was created by the all-glass front.

In the future we will apply much more discrimination in the use of the all-glass facade. The purpose of the building, the character of the surroundings, the exposure, the climate will be carefully weighed. The result will be fewer all-glass facades and a greater variety in exterior treatments of buildings, which will then truly express varied functions, locations and uses of structures.

Mr. Peter: Do you believe that the return of more ornamentation is likely and desirable?

Mr. Gruen: We have recently witnessed the introduction of ornamentation into metal curtain walls. This happens usually when the desire for more rigidity of metal plate can be met by stamping the metal into patterns. The results are buildings which give the appearance that they suffer from a skin disease, with large pimples,

This glass enclosed mall of the 56-acre Wildwood shopping center will enable patrons to go to and from any one of the seventy-five stores in a year-round atmosphere of nature in full bloom . . . flowers, shrubbery, trees complete with canaries. Paintings, sculptures and water fountains adorn the mall with tree-shaded benches provided for relaxation.

GRAND
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or structures which resemble sardine cans. It is, as if the old pressed sheet metal ceiling of the 5 & 10 cent store were moved into a vertical position and applied to the outside of structures. This utilitarian approach will not lead to a revival of richer building surfaces. Only if enrichment is the result of creative process, only it if has a spiritual basis, only if it is organically conceived will it celebrate its rightful return.

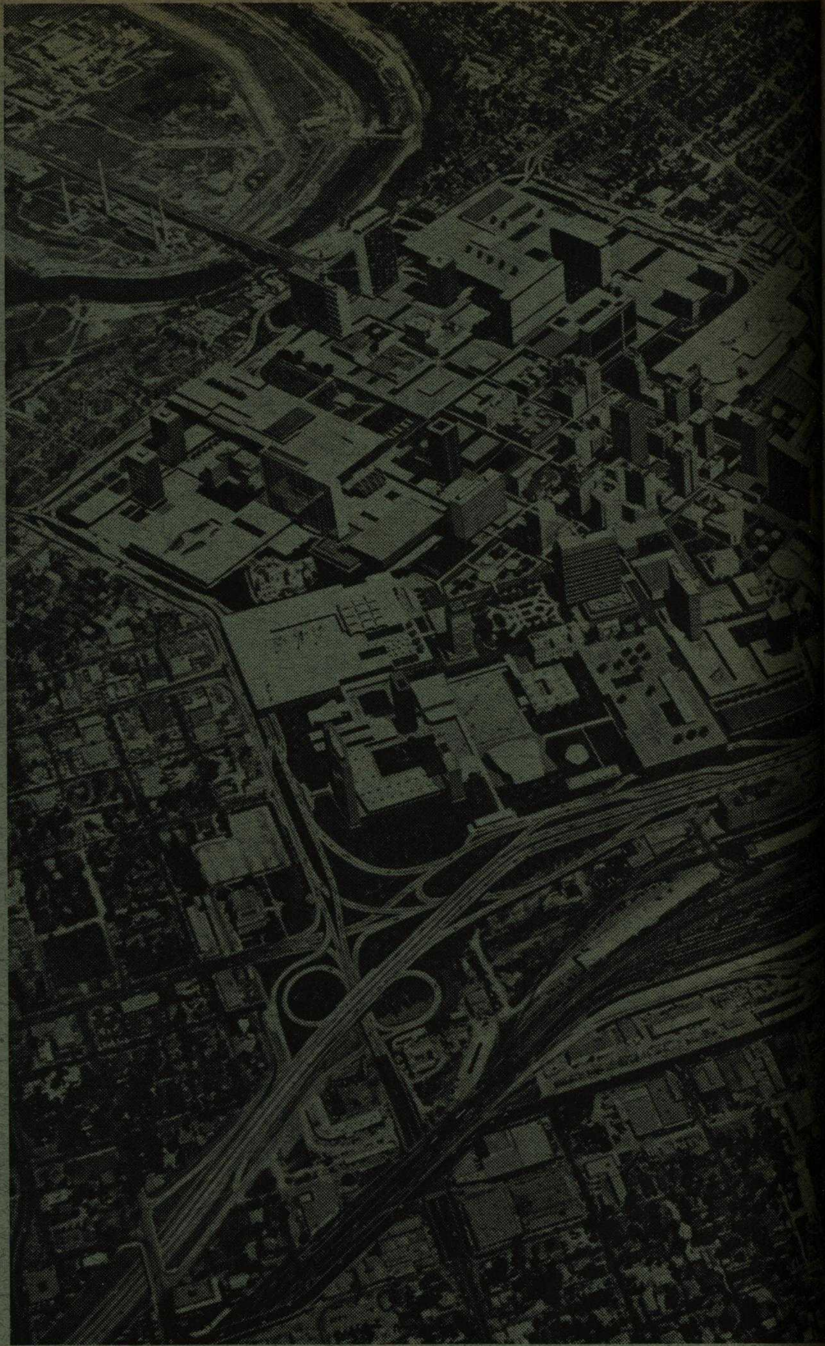
Mr. Peter: You and your firm have, in recent years, been very active in the field of urban planning. This is quite unusual for architects. Could you tell us what caused this emphasis on planning?

Mr. Gruen: I feel very strongly that architecture finds itself in a precarious position. Technology has changed our mode of living dramatically. In the last forty years, our urban centers have not only grown tremendously in human population. They have also been invaded by a new population 60,000,000 strong—the automobile population. Our streets, roads and squares have become storage places for moving and stalled tin. Traffic considerations today are overriding all other planning or design criteria. Our cities have become unlivable and unworkable. As long as the architect's efforts are directed only toward the shaping of the individual structure, they are, under today's circumstances, wasted efforts to a large degree. As long as pedestrians have to concentrate on watching for onrushing traffic, as long as drivers must concentrate all their attention on traffic lights and the car in front of them, there is little chance that even the most brilliantly conceived structure will be scrutinized or even observed except through the help of pretty photographs in architectural magazines.

Thus the challenge for architects as shapers of the human environment is, today, the creation of a truly humane environment.

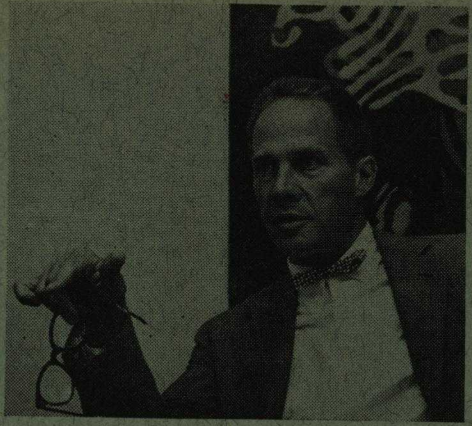
By the means of complete separation of mechanized traffic from foot traffic, we have been successful in creating new types of urban environment in the landscaped courts and malls of large regional shopping centers like Northland and Eastland in Detroit, Southdale near Minneapolis, and the Wildwood project in Milwaukee (illustrated on Pages 95, 98 and 99). On a much larger scale, the revitalization project for downtown Fort Worth (illustrated on Page 100) strives to accomplish the same aims for the downtown area of a large city.

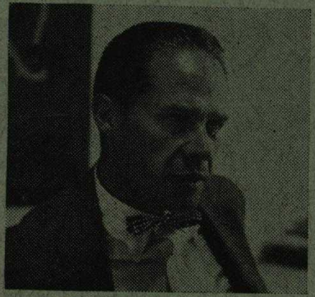
Once our human activity centers are freed from the sight of moving vehicles and traffic signs, dangling wires and gas stations, from the sounds of screeching brakes and automobile horns, from the smells of poisonous gases; once human beings can again walk on their own two feet, undisturbed by the disturbing manifestations of technology, they will be able to look around themselves, to observe and to contemplate. Then and only then will the renaissance of architecture and the arts be possible.

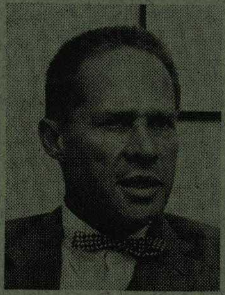


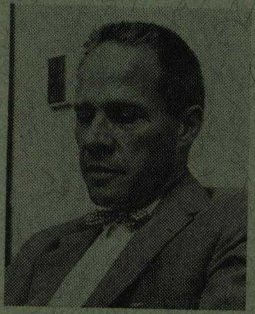
This bird's eye view shows the location and general plan of the proposed downtown Fort Worth development with its three-hundred-acre pedestrain island which will have service tunnels for delivery trucks, open-air courts, gardens, malls and large parking garages. A belt parkway will encircle the whole district. Adjoining it are parking garages for 60,000 cars.

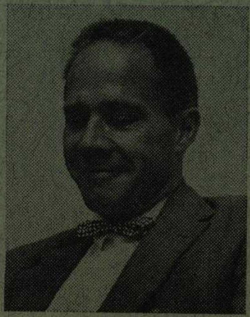
Eliot Noyes An architect and designer with a talent for color and form











Mr. Peter: What is the place of aluminum in modern architecture?

Mr. Noyes: I think aluminum has joined the other materials that are a part of our vocabulary. Because it is different from the others and has its own special and rather intriguing characteristics, it offers a kind of new range of things. Where aluminum is the right material, it's the right one because steel isn't or wood isn't or stone isn't. If you scrutinize the nature of the problem—the nature of the material—it suggests ways of using it right. This is the area where the designer or architect has to be sensitive to these qualities and use it appropriately, and avoid the inappropriate uses.

I think it's the simple business of saying that a concrete building will have different forms than a steel building, because of characteristics that are inherent to concrete in one case and steel in another. So the moment you switch from those to aluminum, you find that you cannot use it the way steel is used. Therefore new forms must be devised to enable it to do the job. Of course, it will look different. It's bound to.

I think a lot of aluminum has been used almost as though it were steel and a lot of thinking about it has been done that way—as if it were a cheaper stainless steel.

Mr. Peter: What do you think about color in architecture?

Mr. Noyes: I think color in architecture is dandy. I like the idea of putting color into architecture, but every time I've tried to do it vigorously, I've suddenly backed away again. I did a laboratory for IBM where I was all set to put in colored porcelain enamel panels in the spandrels, then I thought five years from now I'm going to come and look at that color and think, oh, brother, I'm sick of that color. And so I backed off into two shades of alternating grays. I did find the other places on the building where I could put strong color accents, so it twinkles very well after all.

The same thing was true on my own house—all natural materials and mostly brown and black. I then introduced color through a Matisse rug, a red Calder mobile, accessories and furnishings. I feel more sure doing this than I do introducing color into the building itself.

I've seen an awful lot of people try to do it, particularly in schools. You know, this game of "Let's paint one door red and the next one yellow and the next blue" becomes so cute that you can hardly stand it.

When we were in architectural school, I recall, this business about the function was a very crystal clear thing in my mind. Then came the arguments. You know, the drafting room arguments in school . . . "I'm going to put a vase out in front on my driveway, on a pedestal or something. Isn't it functional too? Its function is to give me pleasure as I come into the house." This seemed an immediate distortion of what was to me a very crystal clear thing. We used to have real battles about it, but it seems to me that the nice thing about the functional idea was you could knock off this vase argument and say that is exactly what it does not mean. The usefulness of our concept of functionalism was in its very clarity. It meant that forms of things were derived from their uses somehow. To be beautiful wasn't a use, so the vase argument wasn't valid. As that was our clue, it really took us quite a ways.

Mr. Peter: It would be harder to argue that today: against the vase man as functional.

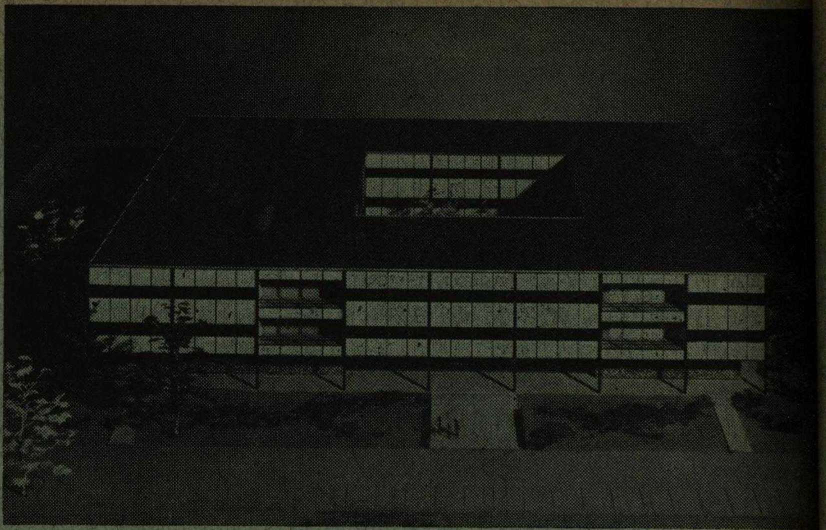
Mr. Noyes: Well, I would still argue the same point. I'd say—if we're talking functions or functionalism, it's good and clear in architecture. It helps to leave the word functionalism to describe how plans or elements of a building work well because they've been arranged for functional efficiency—like having bathrooms near bedrooms or providing sun control louvers on a fairly scientific basis.

Mr. Peter: Except that the man who really said form follows function was Sullivan and in Sullivan's mind he was being functional even when he added ornament.

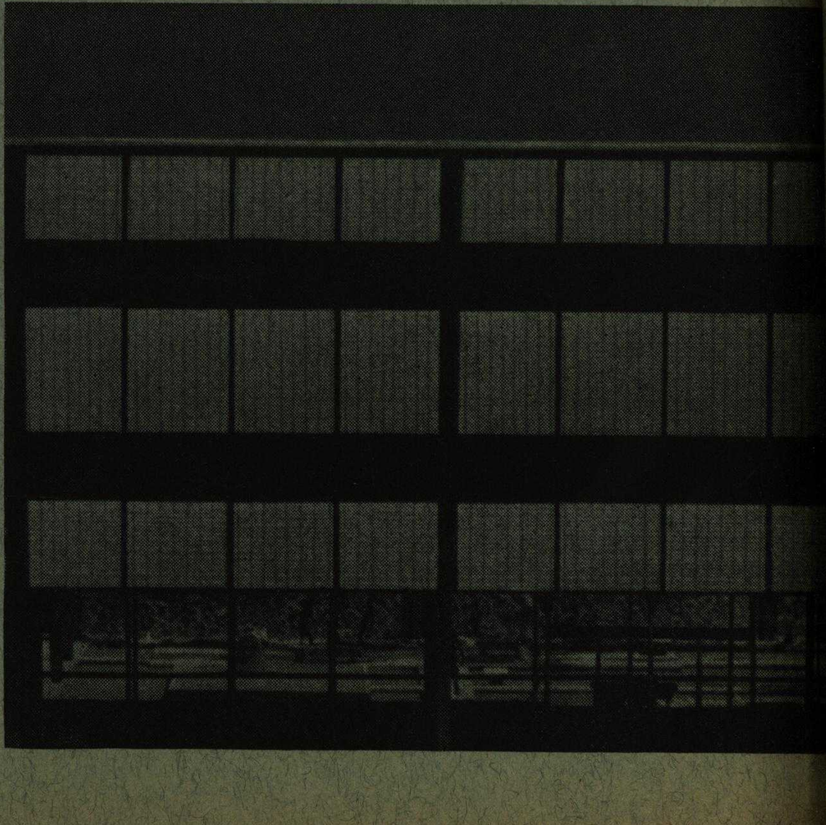
Mr. Noyes: I don't think that we were talking Sullivan language. We had a phrase which sounded like support for the functional idea. We were applying an idea. Maybe it was a limited thing, but at least it had sharp cut-off points and that was good about it. It was so clear as to where it began and ended. That is what helped make this whole escape from tradition possible, and the appeal of it was that so many of the buildings that we were inhabiting—houses, classrooms, dormitories—functioned so badly in this all-so-clear sense. We said to ourselves, let's solve that one thing and we're off to the glorious future. We didn't realize at the time that this was still too limiting for really great architecture, but it sure was a good clue at the time. And it appealed to your reason.

In an office that I was working in one summer, they had sold a gymnasium to some town on the basis that it had four columns out front of sort of a brick building. It came to bids and it cost too much. It looked the columns would have to go. But they'd sold the job on the basis of the columns, they had been limestone, but now they thought and thought, and finally they decided they could make them look like limestone. They did some trick of making them out of plywood, which they painted with glue, and they put sand on it. They made it like sandpaper, so it looked like limestone. The town was happy, and the architects were happy.

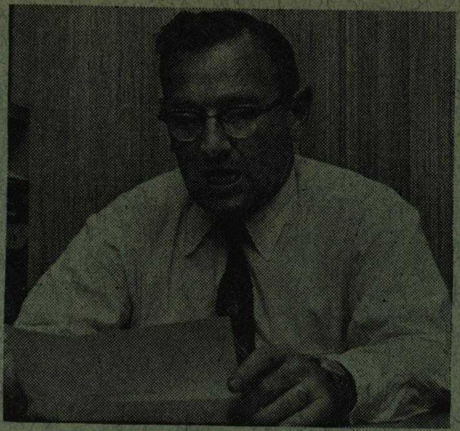
To me this was sort of shocking. We were all very much concerned with things like honest use of materials along with functions. You know, looking back, they were pretty darned good things to help us break away from all the nonsense that was going up around us. They still are.

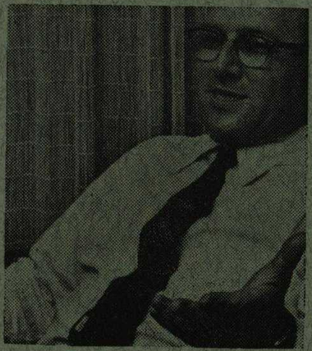


The IBM Educational Center is located in the town of Poughkeepsie on rolling ground adjoining the IBM manufacturing plant. This school is used to train IBM personnel concerned with the sales, operation and maintenance of the various IBM machines. Ceilings of perforated, corrugated aluminum function as an acoustic control and as a means of distributing air from overhead ducts evenly throughout the building.



Lev Zetlin An engineer with a sharp pencil and an imaginative approach





Mr. Zetlin: To your question, what is the place of aluminum in architecture, I do think that it really has a place. Economy is the whip of both engineering and architecture. Aluminum could be made cheap as a structural material. The more we know about aluminum, the more we use it. We know that the taste of society runs with the available materials. It just so happens, you know, that people like what is available. Some unique people have unique tastes, but in general that is what happens.

Mr. Peter: Why isn't aluminum used more widely as a structural material in architecture?

Mr. Zetlin: Let us put it this way, that a lot of thought has been given to using aluminum structurally. However, there are several considerations to the use of aluminum. One is its cost, volume per volume or load resistance. When we have two structures with the same load resistance, aluminum up to now was, in many cases, more expensive. There is advantage, of course, in the lightness of aluminum, which may balance this off to make it cheaper.

But up to now, the question still comes why aluminum hasn't been used too much in structures. One of the reasons is the lack of knowledge on the part of engineers. As we know, engineering is a combination of art, craft and science. Craft is an important part. When I say craft, I mean knowledge accumulated by tradition . . . by experience, rather than by scientific means of predicting. We are free with steel and we can work with it, not because it is better than aluminum, but because it is more well known as a material. With aluminum, of course, we know a still bit less today than we know about steel. Although quite a lot is known about its behavior in aircraft structures, the application is a little bit different than in civil engineering. You see, in civil engineering or in structural engineering, the material is not used with such refinement in design as it is in aircraft structure.

There is, of course, another big problem with aluminum, and that is its elastic properties. All of our engineering science is based on certain theories which have been developed for elastic materials. With an applied load, the theory of elasticity holds that the stress is proportional to strain and vice versa. But in aluminum, this is not entirely true, at least it is only true up to a certain point.

I think aluminum will find its place in structures particularly because of the large amount of aluminum going into aircraft structures. I think that some day it would be possible to design more structures more economically with aluminum.

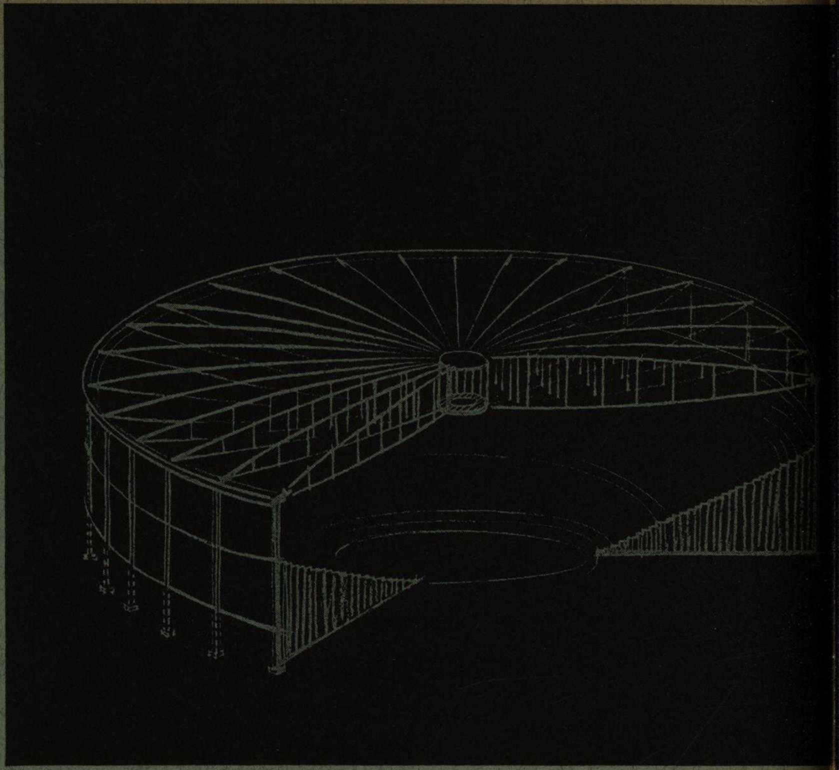
Mr. Peter: You referred to the refinement of design as practiced in the aircraft industries. Is there any reason why there shouldn't be this kind of refinement in the design of buildings?

Mr. Zetlin: Well, I would be the last person to say that it wouldn't be necessary in our field of structural engineering. I definitely believe that it is necessary. But we have to figure ourselves into the line of what is going on in the general practice. In civil engineering, design is governed so much by codes.

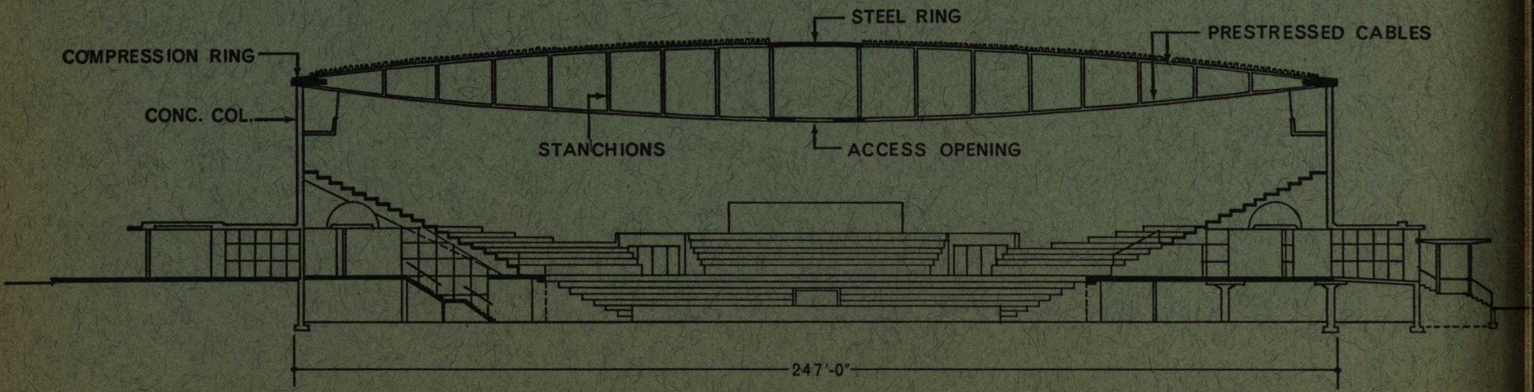
But also there is an economics problem . . . . I mean the fees that engineers are paid. An engineering office cannot permit itself to go into the refinements in design employed in the aircraft industry. When a design leaves the drafting boards in the aircraft industry, it is used for thousands of airplanes. In engineering you take one project and your work applies only to that project. Nevertheless, refinement is still possible, but it will come around in another way. In the aircraft industry, the designing body actually goes into the refinements. In structural engineering, refinements will come about through other means . . . . essentially the national codes and specifications. A certain body of men will do that research and boil down the research and findings to a set of rules like those used today in steel design or timber design.

Take timber! Timber is a material which has properties much different from homogeneous materials. Nevertheless, we do have quite a lot of information about wood behavior under extreme cases of loading. This was possible again, because so many years have been spent on wood structures. Research has been done. Also timber is a little bit different. It is a material which couldn't be applied to all types of structures. It has narrower limits. Although it is material with not strictly defined elastic and strength properties, we do have a set of rules today for its design. Aluminum, of course, will be in a much better position than timber, when a similar set of design rules are completely developed.

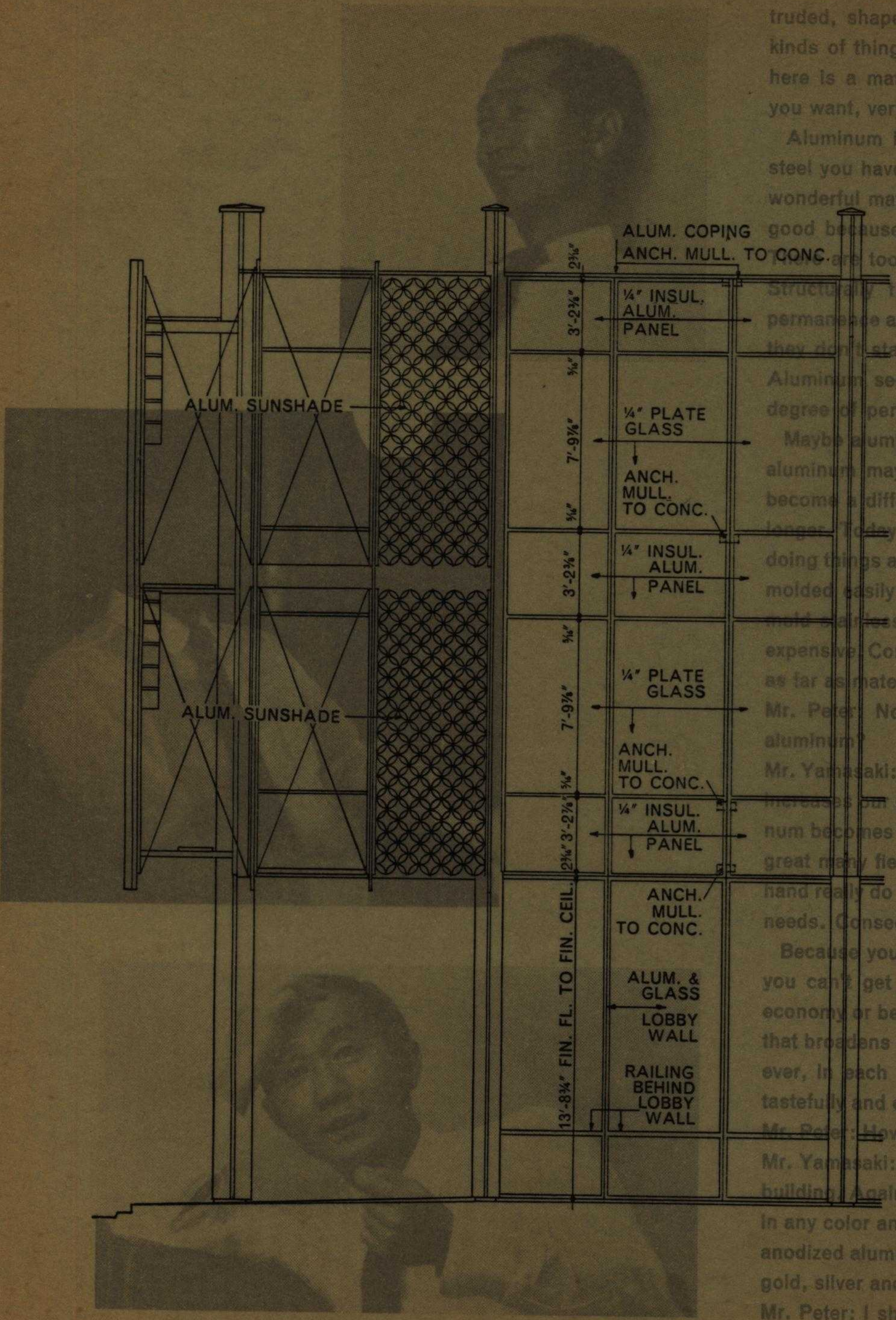
It is quite possible that a point will be reached where the lightness of aluminum and the fact that it can be prefabricated will enter importantly. The more research put in, the better for the industry and the better for the engineering profession in general.



An example of Zetlin's advanced thinking is his interest in suspension structures. A typical example of his imaginative engineering is this design for a municipal auditorium in Utica, N. Y. The sketch and cross section drawing show how a lightweight roof will be supported on twin pretensioned cables separated by vertical studs and covered with a light metal decking. In the center, they are fixed to a tension ring and at the circumference to a reinforced concrete ring. Architects are Gehron and Seltzer.



Minoru Yamasaki An architect with a deep sense of beauty and delight



Mr. Yamasaki: I believe aluminum has a very important place in modern architecture. I like aluminum because it is a very pliable material. You don't realize how pliable it is until you see it extruded, shaped, formed. When you see this visually, then all kinds of things happen in your mind. You begin to realize that here is a material that takes the form of architecture, or what you want, very easily.

Aluminum is much more plastic than steel. For instance, in steel you have to follow the particular mill form. Aluminum is a wonderful material in that the finish lasts. To begin with that is good because we need materials which have [illegible]. There are too many modern materials which are impermanent. Structurally they are good, nevertheless [illegible] permanence and when we put them up [illegible] and glass, they don't stand up. We need materials [illegible]. Aluminum seems to be the easiest to work [illegible] with any degree of permanency.

Maybe aluminum is a good testing ground [illegible]. The present aluminum may not be the building material of all time. It may become a different alloy or whatever, which is harder and lasts longer. Today we are reaching for new forms and new ways of doing things and we need a relatively flexible [illegible] molded easily. We have the [illegible] you try to mold stainless steel, for instance, you [illegible] it's too expensive. Consequently we need a material like aluminum which, as far as materials go, certainly stretches our horizon.

Mr. Peter: Now, what do you think, quite frankly, of colored aluminum?

Mr. Yamasaki: I'm not going to evade the question. Anything that increases our pallet is wonderful, and if and when colored aluminum becomes [illegible] a permanent thing, I think it opens up a great many fields simply because the materials that we have on hand really do not give us the pallet that we need to cover today's needs. Consequently we are always searching for new things.

Because you want a certain quality in certain materials which you can't get from what we have on hand, either because of economy or because it just doesn't exist, I would go for anything that broadens the scope of materials that we have at hand. However, in each of these instances that material has to be used tastefully and carefully or you are in trouble.

Mr. Peter: How do you like black as a color?

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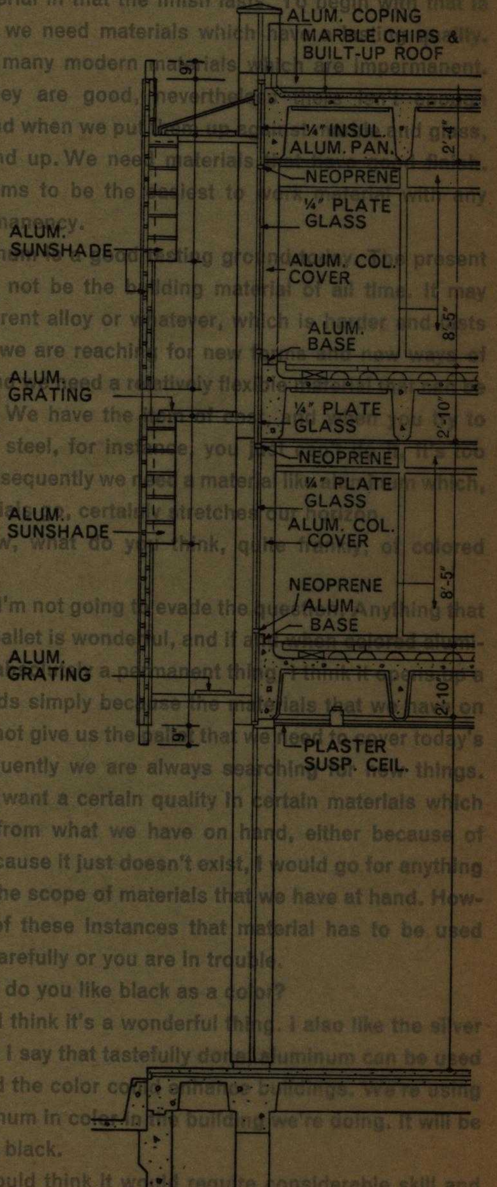
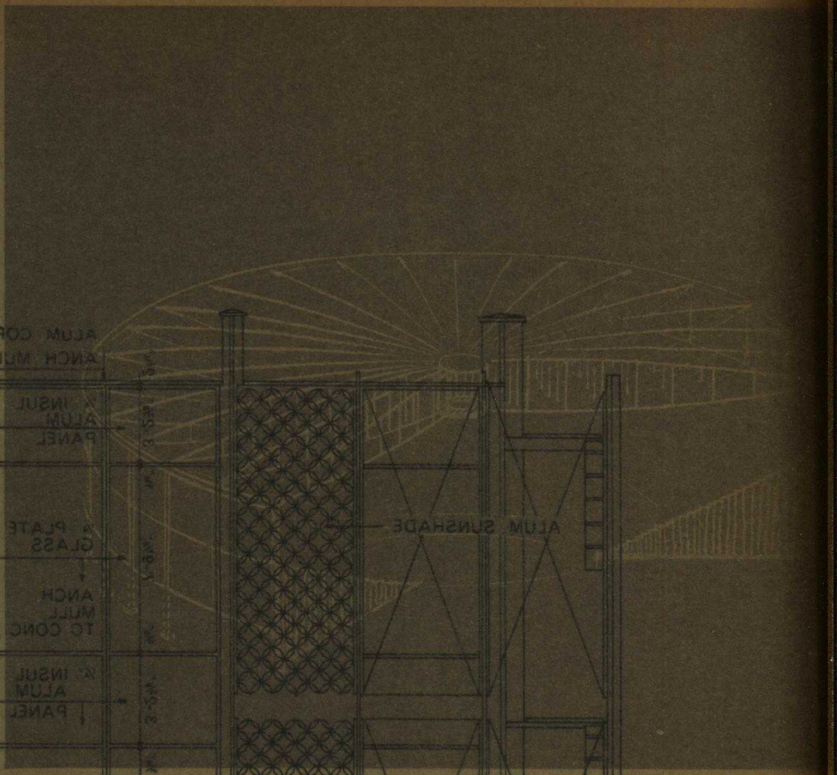


believe that it is necessary. But we have to figure ourselves into the line of what is going on in the general practice. In civil engineering, design is governed so much by codes.

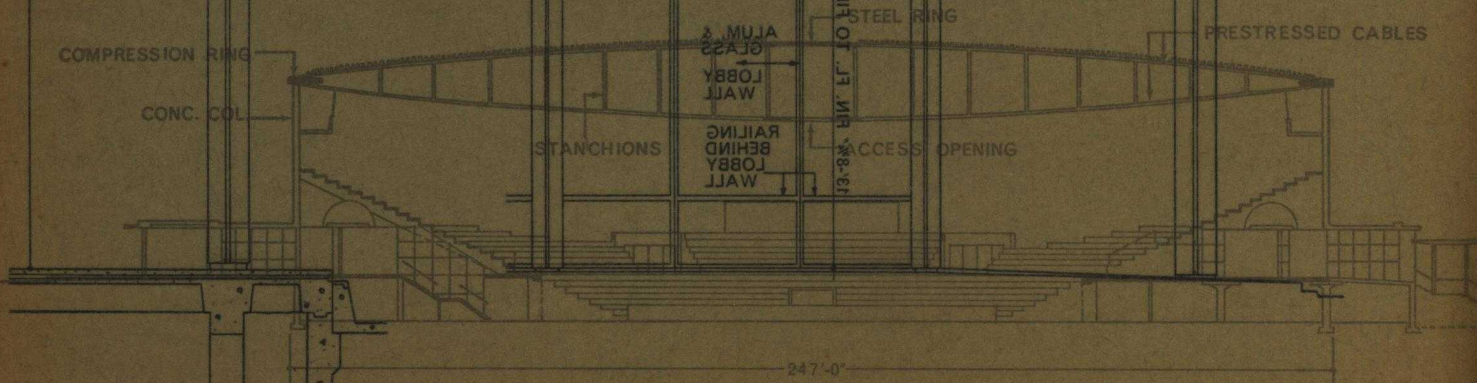
But also there is an economics problem . . . . I mean the fees that engineers are paid. An engineering office cannot permit itself to go into the refinements in design employed in the aircraft industry. When a design leaves the drafting boards in the aircraft industry, it is used for thousands of airplanes. In engineering you take one project and your work applies only to that project. Nevertheless, refinement is still possible, but it will come around in another way. In the aircraft industry, the designing body actually goes into the refinements. In structural engineering, refinements will come about through other means . . . . essentially the national codes and specifications. A certain body of men will do that research and boil down the research and findings to a set of rules like those used today in steel design or timber design.

Take timber. Timber is a material which has properties much different from homogeneous materials. Nevertheless, we do have quite a lot of information about wood behavior under extreme cases of loading. This was possible again, because so many years have been spent on wood structures. Research has been done. Yes timber is a little bit different. It is a material which couldn't be applied to all types of structures. It has narrower limits. Although it is a material with not strictly defined elastic and strength properties, we do have a set of rules today for its design. Aluminum, of course, will be in a much better position than timber, when a similar set of design rules are completely developed.

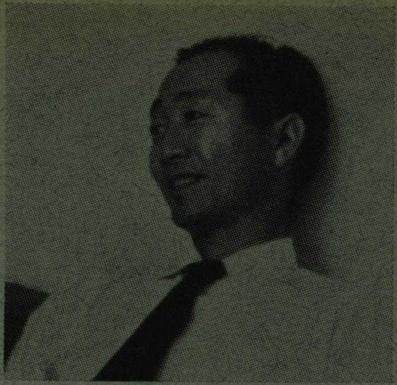
It is quite possible that a point will be reached where the lightness of aluminum and the fact that it can be prefabricated will enter importantly. The more research put in, the better for the industry and the better for the engineering profession in general.

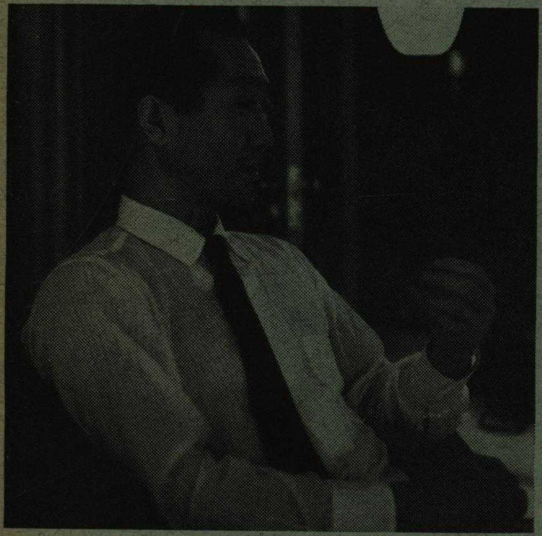


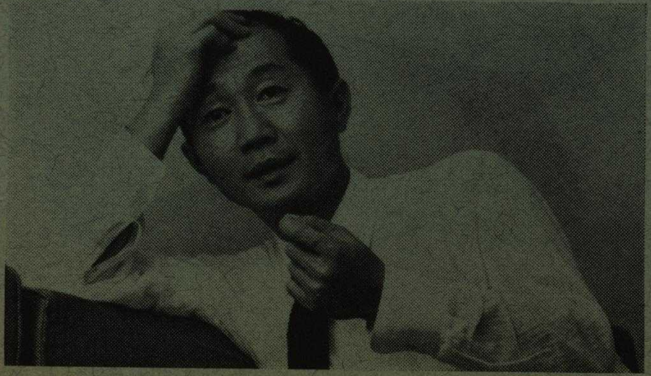
An example of Zetlin's advanced thinking is his interest in suspension structures. A typical example of this imaginative thinking is his design for a municipal auditorium in Utica, N.Y. The sketch and cross section drawings show how a lightweight roof will be supported on twin prestressed cables separated by [illegible] and covered with a light metal deck. In the center, there is a [illegible] tension ring and at the circumference a reinforced concrete ring. Architects are Gehron and Seltzer.



Minoru Yamasaki An architect with a deep sense of beauty and delight







Mr. Yamasaki: I believe aluminum has a very important place in modern architecture. I like aluminum because it is a very pliable material. You don't realize how pliable it is until you see it extruded, shaped, formed. When you see this visually, then all kinds of things happen in your mind. You begin to realize that here is a material that takes the form of architecture, or what you want, very easily.

Aluminum is much more plastic than steel. For instance, in steel you have to follow the particular mill form. Aluminum is a wonderful material in that the finish lasts. To begin with that is good because we need materials which have a lasting quality. There are too many modern materials which are impermanent. Structurally they are good, nevertheless there isn't enough permanence and when we put them up against marble and glass, they don't stand up. We need materials that have good finish. Aluminum seems to be the easiest to work material with any degree of permanency.

Maybe aluminum is a good testing ground today. The present aluminum may not be the building material of all time. It may become a different alloy or whatever, which is harder and lasts longer. Today we are reaching for new forms and new ways of doing things and we need a relatively flexible material that can be molded easily. We have the item of cost, and when you try to mold stainless steel, for instance, you just can't do it. It's too expensive. Consequently we need a material like aluminum which, as far as materials go, certainly stretches our horizon.

Mr. Peter: Now, what do you think, quite frankly, of colored aluminum?

Mr. Yamasaki: I'm not going to evade the question. Anything that increases our pallet is wonderful, and if and when colored aluminum becomes absolutely a permanent thing, I think it opens up a great many fields simply because the materials that we have on hand really do not give us the pallet that we need to cover today's needs. Consequently we are always searching for new things.

Because you want a certain quality in certain materials which you can't get from what we have on hand, either because of economy or because it just doesn't exist, I would go for anything that broadens the scope of materials that we have at hand. However, in each of these instances that material has to be used tastefully and carefully or you are in trouble.

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Mr. Peter: I should think it would require considerable skill and daring to use the color gold.

Mr. Yamasaki: Why? Gold has been used in buildings before. Look at bronze buildings or brass. Why are we afraid of them?

We have swung a pendulum away from the early 20th century architecture, narrowing our horizons in every field, simplicity, lack of color. For instance, you couldn't use stone or marble for a while. All of this, I think, is tending to erase itself now. We've started to broaden our horizons and include our whole pallet. Heavens knows our pallet isn't large enough to use tastefully. I think that man needs variety.

I would think it would be deadly if we narrowed our sights to the point where we only had one kind of architecture, one solution, one kind of material, for our total environment. This would be really a sickening kind of environment, monotonous and boring.

In early modern architecture it was necessary to focus our thinking, in a sense. It was necessary, much as the simplicity of the early part in any period in architecture.

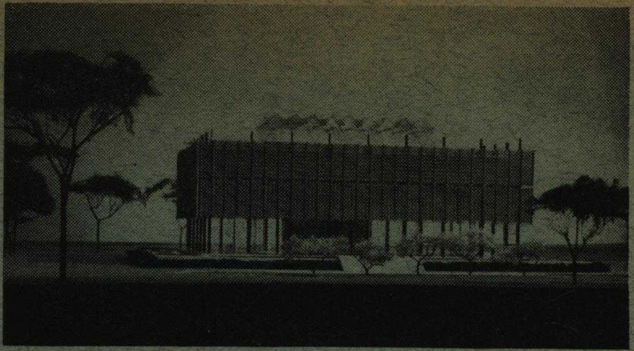
In Romanesque, in Gothic it was the same thing, and it flowered into a richer kind of architecture as it matured. In the same way, I think that our architecture had to sort of focus our sights by returning to the simple, basic thing. But then because we are such a complex civilization, because we do have this incredible amount of material on hand and because of our technology, of which we have an immense variety, I think it's wrong to say that you should limit yourself with one kind of thinking on architecture of any kind.

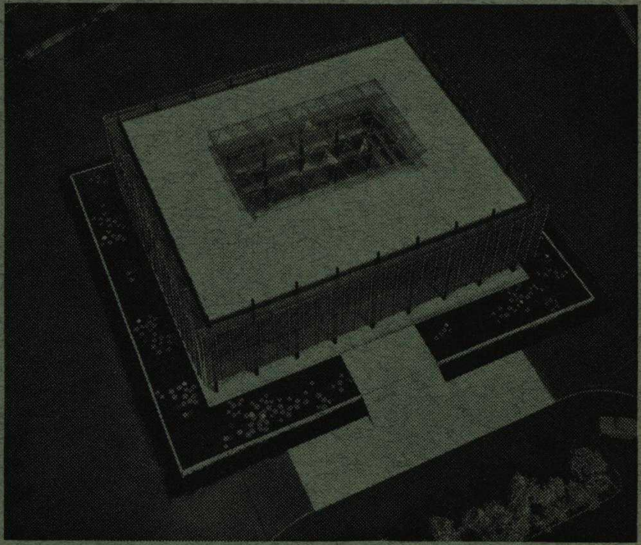
The richness of our society is going to be evidenced by what we can produce with the materials on hand, and the gauge is how tastefully and how thoughtfully we can do this.

When we were given the job here in Detroit to design for Reynolds, we were asked to do the most exciting building possible in aluminum. This was a marvelous job to work on, obviously. Since this is in a sense the center of manufacturing, industrial operations, and automobiles, it was the desire to dramatize aluminum as a material. The building will be one way of getting the point across. Consequently, we went all-out because this was a very good opportunity.

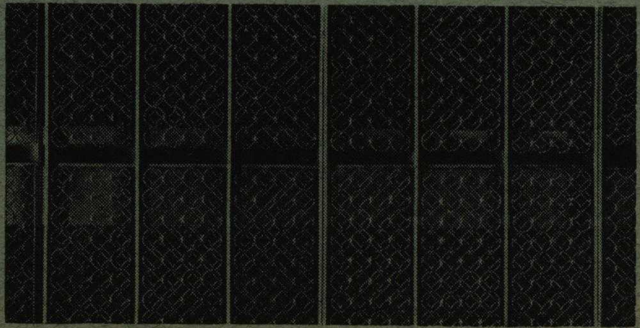
The need in this building was to do something different. Just to do another window or another skin didn't seem to be the solution because obviously there are 10,000 skins in aluminum today. Just to provide another one proves nothing, in a sense, so far as this building is concerned. We've done some glass buildings and have had some real problems with those buildings because of the sun. We thought that if we could devise a sunscreen for this building, that would be exciting in aluminum. This would be something.

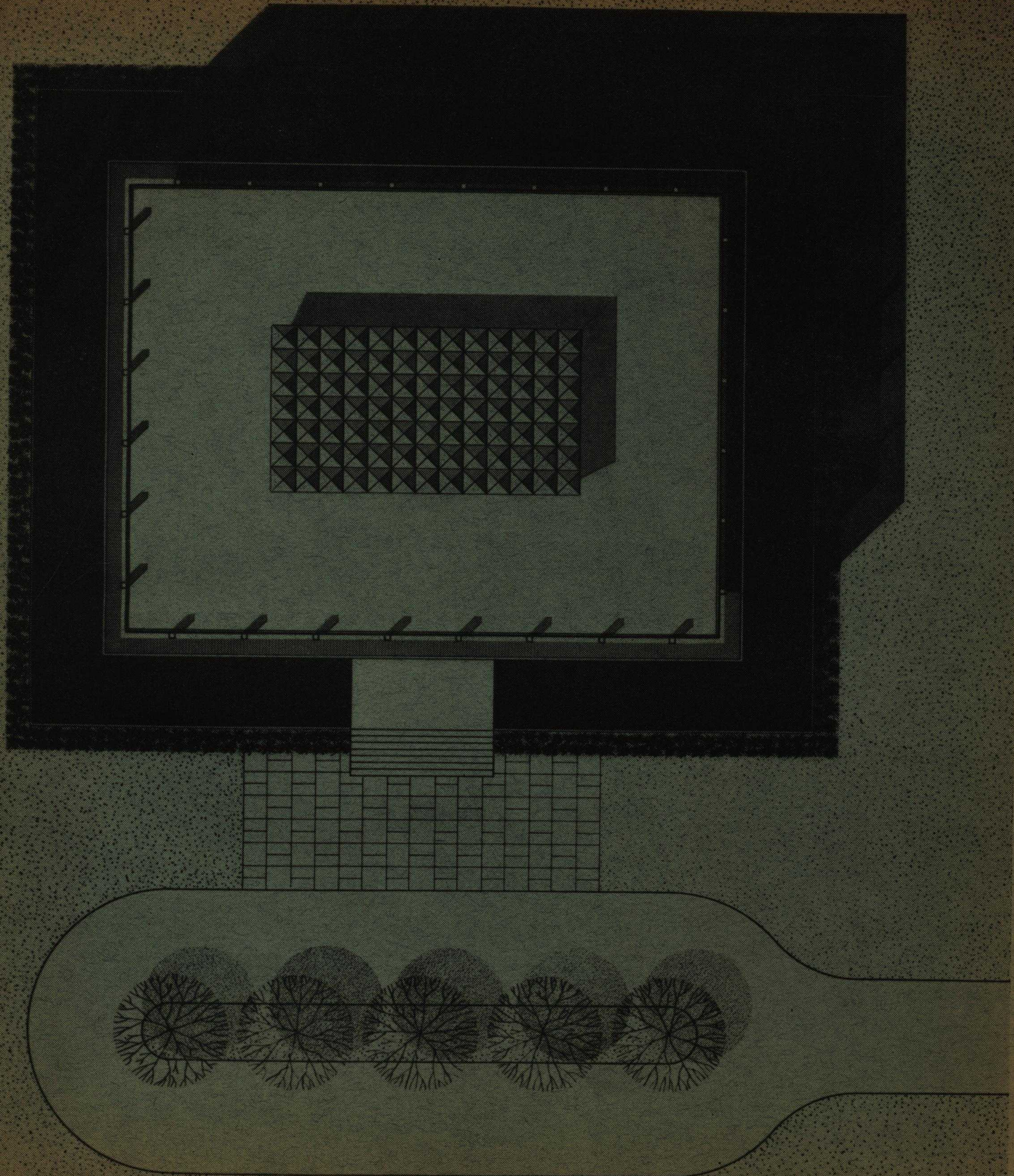
The other thing that I have been interested in is that buildings should have ornament. But at the same time I think that the





Above and Middle This building for the Reynolds Metals Company has been designed to exist in the sun. Its eaves, skylights, walls and screens of aluminum have been calculated to admit, exclude or modulate the light in useful and pleasing ways. **Below** This screen of gold anodized aluminum is made by a double layer of sections cut from 10″ diameter extruded aluminum tubes.





ornament cannot be carved by hand.

It can't be handicraft because obviously this is solving nothing. If we do, we are just being somewhat sentimental and proving nothing. But if we can produce really lovely ornaments through machine—machine-made ornament—then we are proving something because then again another element in architecture becomes a part of our technological building. Also, I believe that ornament as such is often just plastered to the face of the building and isn't good. It has to arise from a need. Consequently, the screen to shut out the sun from the building can add richness to the building and then it answers a need. It is an integral part of the building.

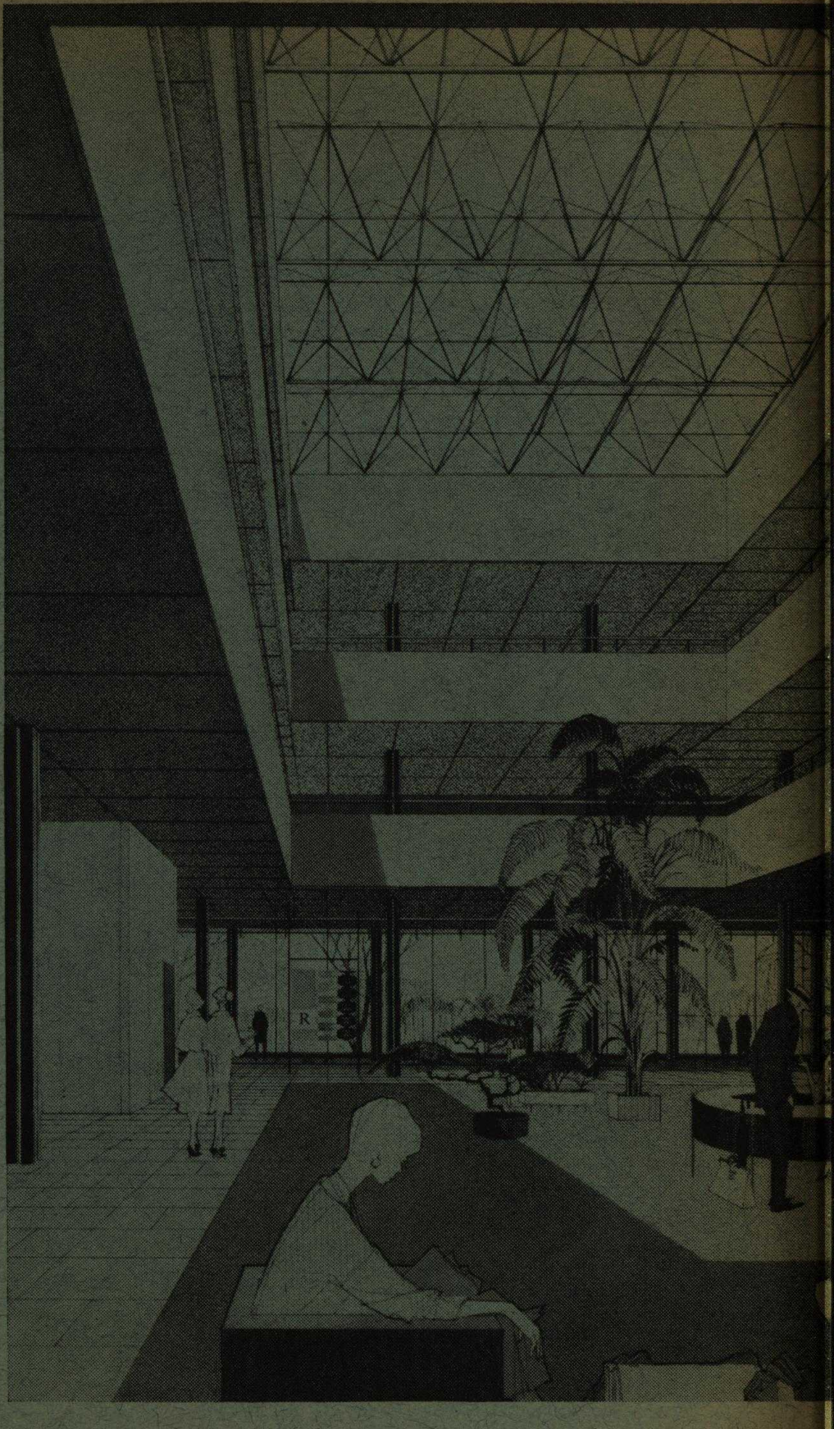
However frivolous some of the new things that the young architects are trying to do today may look, it still is part of our heritage—part of our education down from the masters. The elements that we put into a building must be integral with the building. We can't do the baroque yet, and I hope we don't.

This is a building which must attract a lot of attention. We put it up on a podium which is a good way to place emphasis on the building. We also wanted to have it provide more excitement than just looking at the screens from the outside. We thought that if we had this display floor below—it's in a sense on stilts—then we could walk through the building underneath the screen, into the building and look up and see the sky. The Larkin building has it. This secondary excitement would be fun for the building too so that it would have more depth than just the skin itself. I think the interior is going to be good. I don't think that you realize that it's going to be good by just looking at the model.

I think that was true of the St. Louis Airport, for instance, that people were intrigued with the outside. Yet the best part of the St. Louis Airport is the interior. We had made models and I had made drawings of it, but that didn't prove anything until you walked into it. I hope that inside the building here we'll have the same element of surprise and excitement.

I think that function is an important part of the building. But you know, there's a thousand ways to solve function in a building.

The normal relation of one office to another can be solved a thousand ways, and one is as good as the other. Unless you can get a kind of spirit about a building, why, there's nothing.



Here with aluminum in many regular roles: windows, partitions, ducts, grilles, doors, railings, column covers, flashings and furniture, it also appears in original uses: space frames for the skylight and luminous ceilings.

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